PAVING AND MUNICIPAL ENGINEERING

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

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Communications are invited, and all requests for special information on the subjects treated by this journal will receive careful attention.

Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

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The columns of this publication are open to the discussion of all subjects relating to paving, sewerage, water-works, street-lighting, and the physical improvement of cities. Practical information as to the merits of materials used in such work and new methods, with photographs and drawings, which may be used for illustration, are especially desired. We are glad to get brief notes as to proposed improvements and the letting of large contracts.

City engineers are requested to send us as early as possible copies of their annual reports, which will be given proper notice.

Articles relating to methods of road making and maintenance are invited.

ASPHALT AND ITS USE IN PARIS.

By Louis H. Gibson, Our Special Representative in Europe.

FOR material which is so much used there is generally little known about asphalt. People know that the principal beds are Val De Travers, Seyssel, Ragusa, Chiavarochs and the Island of Trinidad. But the ease with which it may be counterfeited, and for the time being be not generally detected, is not publicly recognized. The reasons for this are in its chemical composition, which are generally known to specialists, but not to the general public. It is a carbonate of lime impregnated by natural means with bitumen; it is a natural rock. This rock softens at an ordinary temperature and hardens with cold. Under a temperature of over 50 to 60 degrees Centigrade the rock turns into dust. It then possesses a very peculiar property. If compressed energetically there is obtained a hard and solid body which is none other than the original rock; that is, after it is heated if compressed during the process of cooling it is transformed into its original state of hardness.

An examination under the microscope shows that it is composed of very fine grains of carbonate of lime surrounded by bitumen, which latter material acts as a cement in binding the entire mass together. One may readily perceive that under a high temperature, the bitumen melts and the grains fall apart. Under a high temperature and compression they may be reunited. This fact should be clearly understood in order to know how to handle asphalt successfully. It should be known that it falls apart into powder under an ordinary temperature and that under a higher temperature and compression before it cools it may reassume its original condition of hardness. It is highly important to realize this in practically using it. If it is not heated sufficiently and maintained at that temperature during compression it can not permanently perform the office intended for it. This fact should be thoroughly understood by all who have to do with asphalt.

It is generally known that the most important bed of asphalt is Lake Trinidad in the Antilles. However, new discoveries are being constantly made; it oozes from certain rocks and mines of asphalt. A peculiar general quality in connection with all these deposits is that it is solid below ten degrees Centigrade, elastic from 10 to 20 degrees, doughy from 20 to 35 degrees, and viscid and then liquid from 35 to 50 degrees.

One of the best French authorities gives the composition of the bitumen of the natural asphalt as follows:

Carbon	87.00
Hydrogen	11.20
Oxygen	1.80
Total	100.00

It surrounds, as stated above, the carbonate of lime, which is impregnated geologically to form asphalt. It is of a dark brown color, and when broken presents a granular and irregular surface. If it is exposed to the sun it becomes whiter in color. This is none other than the carbonate of lime from which the bitumen has evaporated.

Uses of Asphalt.—Asphalt is used in two different states: First, as compressed asphalt; second, as asphalt in a state of fusion. In the first state it is used principally for covering streets; in the second, the same as for sidewalks and terraces.

When to be used in the compressed state the rock, when taken from the mines, is first broken mechanically in a crusher and then sifted. It is then sent to the place where it is to be used, and there heated to about a hundred and thirty degrees Centigrade before being practically used.

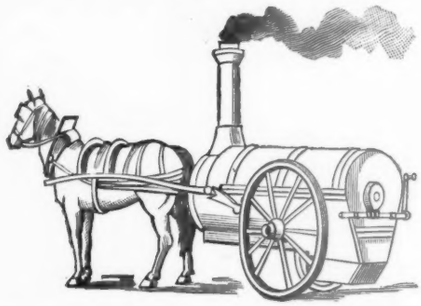
The following is the method of procedure in Paris: It is not heated in the place of utilization but at a central station, and conveyed in heaters composed of sheet iron, which preserves the heat long enough for a distance of two miles to be traversed.

An eminent French authority says: "In order to construct a good street it is necessary that the foundation should be rolled or otherwise rendered incompressible. Upon this surface a bed of cement six or eight inches in thickness should be laid. This should

be constructed with great care. The entire future of the street depends upon it. If it is desired to at any time renew the pavement in wood or asphalt, it is only necessary to remove the upper covering. All of the resistance of the street comes upon the foundation."

It is necessary to give the concrete foundation abundance of time to dry and set. This precaution is indispensable. If an undue amount of moisture should remain in the concrete, the steam developed therefrom, by the heat of the asphalt, will destroy the homogeneous qualities of the latter. The foundation is then covered to a thickness of 2½ to 2¾ inches with the hot asphalt powder. It is then pounded with rammers. That part nearest the curbing with rectangular bottoms and that removed therefrom, with round bottomed rammers. They are first heated and the entire work is done very methodically. Finally the surface is rolled to thoroughly equalize it.

This is somewhat different from the usual practice with us, especially in cities where large use of asphalt has not been made. In Indianapolis, for instance, it is not uncommon to see the powdered asphalt carried in coal carts and other vehicles which are not naturally well adapted for such use. In France and other foreign countries where these matters are closely regarded by those who are well posted in the best use of this material, it is found necessary to provide especially constructed carts which will retain the heat of the powdered asphalt during the entire period of its transfer from the heating station to the street where it is to be used. As explained before, this is of the utmost importance. Furthermore, we are not careful enough about compression. We rub it down and roll. We do not pound it with the rammers, ex-



cepting in certain places where it is not convenient or handy to use the roller. Excessive compression is essentially necessary to reunite the chemical constituents of natural asphalt. And where it is used to the best advantage the use of the rammer is found to be necessary. This rammer is the same tool that is used for settling boulders, broken stone and other similar material, in America. I am aware that we use the steam-roller in connection with asphalt pavement. However, we do not and can not use it while that material is sufficiently hot to be thoroughly reunited into its natural state. The only secret about the use of asphalt in Paris is that they use the natural and not the counterfeit material and that they consider its natural chemical constituents in practically handling it.

Mastic Asphalt—Is used for terraces, sidewalks, and large flat surfaces for foot travel. It is made with a mixture of asphalt and veritable bitumen, and forms the product usually known as bitumen. It is a mixture in the proportion of 350 pounds of bitumen to 3,500 pounds of asphalt. After heating and fusion it is reduced to 3,500 pounds of the mastic mixture. It is then put into molds of about fifty-five pounds each, in which form it is transported to the city or location where it is to be used. When it is desired to melt the mastic, twelve or thirteen of the fifty-five-pound cakes are broken and mixed with free bitumen. The latter is added a little at a time and stirred without ceasing until the mixture reaches the proportions of 715 pounds of mastic and about thirty-five pounds of bitumen. Then gravel is spread on the surface of the liquid, which it penetrates slowly. This is stirred thoroughly and the gravel added a second time in the same manner. Gravel is gradually added until it reaches sixty per cent. by weight of the mastic. The mixture is maintained at a temperature of 150 to 180 degrees Centigrade for two or or three hours, during which time it is regularly stirred.

This operation is carried on, by the workmen, in vertical heaters and under covers. In the large cities it is prepared in a central station and carried to the places of application in portable heaters called locomobiles (see cut), which are drawn by one horse. These portable heaters are constantly maintained at the original temperature of 150 to 180 degrees Centigrade by a fire underneath the shell of the heater.

The asphalt for a sidewalk is laid upon a concrete bed of 2¾ to 3 inches of concrete, followed by a bed of mortar which is about ½ an inch in thickness. In laying the asphalt upon this one takes the same precautions as with street work. The workman spreads the hot mixture thereon to a depth of about three-quarters of an inch. This is done in bands of thirty to thirty-six inches in width, and is spread out and slightly compressed with a wooden tool or spatula, which is easily managed with one hand. While the material is yet warm gravel is scattered over it by hand. This prevents the surface from getting smooth, at the same time that it replaces the gravel which has settled to the bottom of the mixture of warm mastic during the time of placing it on the surface.

The compressed asphalt is susceptible to many frauds. One can prepare the powder of asphalt with carbonate of lime or simply with gas pitch. These products are, in general, very bad and deteriorate rapidly.

The locomobile shown in the sketch is made of boiler iron, and is provided with a feeder in the form of a screw conveyor, which conveys the asphalt to the interior of the receiver to the mouth of the conveyor. The conveyor is turned by the crank and spiral gearing shown in sketch.

Paris, June 22d, 1891.

CONCRETE-MIXING.

GOOD concrete can be made from clean gravel, river ballast, stone chippings, burnt clay, shingle, broken bricks crushed flints, etc.; and the proportion generally adopted by engineers is 1 of cement to 8 of these or similar materials, technically termed the aggregate.

To insure satisfactory results, the following precautions should be taken:

(1) To have the cement shot into a dry shed a few days before using, so that it may be thoroughly cool and air slacked.

(2) To use clean water only.

(3) The cement and aggregate should be raked or turned over together twice dry, and this operation again repeated while the water necessary for hydration is being added. This should always be poured through a rose (any ordinary watering pot is as good a means as any), as throwing on from buckets washes the cement away from the aggregate. Repeat the mixing once more and the concrete is ready, *i. e.*, it has been turned over four times—twice dry, once while being watered, and once afterwards.

(4) When the aggregate consists of crushed bricks or other porous material, it should be thoroughly wetted and time allowed for absorption previous to use, otherwise it will take away part of the water necessary to effect the settling of the cement.

(5) It is often desirable to add a proportion of sand to the aggregate to assist to fill up the corners. When this is done, care should be taken that the sand is sharp and clean—the coarser the better.

(6) Concrete should be used at once after mixing, as to remix or disturb when partially set destroys its setting property.

(7) When used for plastering over brick work, this should be first well wetted.

(8) Slow-setting cement gives, eventually, the strongest concrete.

The proportion of 8 and 1 is named as that usually specified, but with good, tested cement a larger proportion of aggregate may be added.

These hints will be found useful in preventing the misuse of cement, but the writer would recommend all who are interested to know what cement can do for engineering works to read "Grant on the Strength of Cement;" or for more general purposes, "Portland Cement for Users," H. Faija, G. E.; and "Concrete: Its Use in Building," by Thomas Potter.

SPECIFICATIONS FOR BRICK PAVING.

Mr. C. P. Chase concludes his series of articles on "Paving Brick and Brick Pavements," which have been appearing in PAVING AND MUNICIPAL ENGINEERING, with the following specifications for brick pavements:

SEWERAGE, ETC.

[**All sewer, water and gas mains** and the connections therewith, extending, at least, to the inside of the curb line, and all underground cables or wires necessary, at the time or in the near future, should be put in, at least, six months (better a year), before pavement is laid; otherwise **extraordinary care must** be used in returning the earth to the trenches; and all man-holes, catch-basins and grates should be put in at the proper time, so that the curb and pavement can be fitted thereto.]

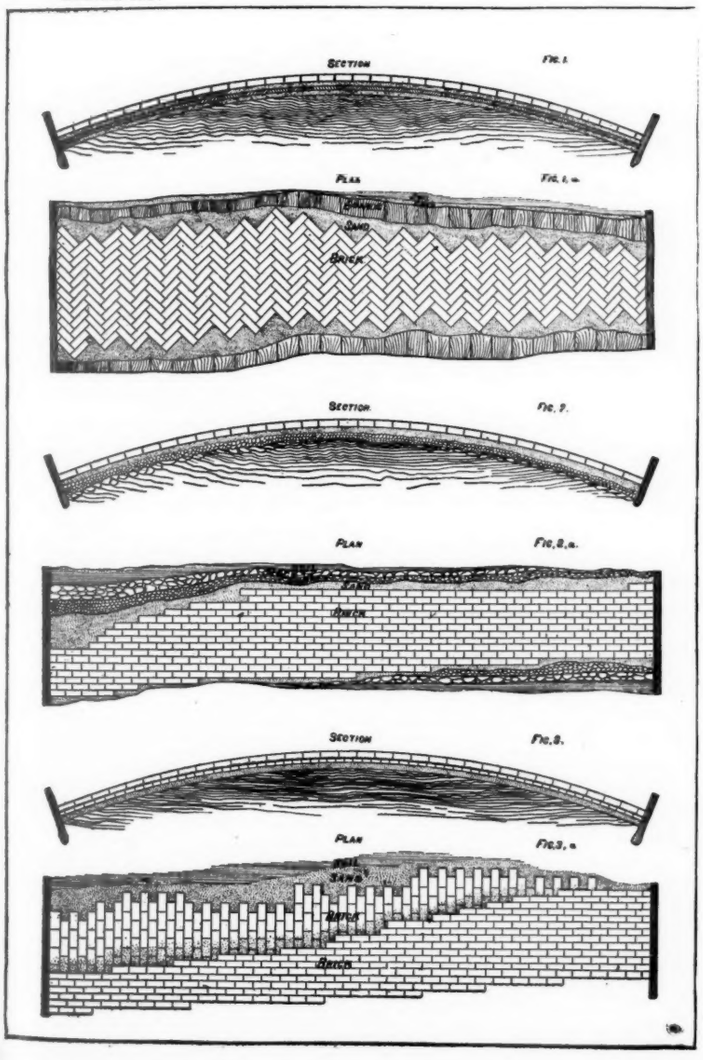
DRAINAGE.

The streets and avenues in the district to be paved shall be suitably tile-drained along the gutters, on either side of the curb, or in the center of the street (when necessary), according to the peculiar circumstances of each case, as specified and directed by the city engineer of said city.

The tile to be of the best quality and to be of the size ( ) and laid the depth and distance apart and in the locality required to give the proper drainage, and as directed by said engineer.

The trenches to be excavated to an even grade at the bottom, and the tile laid on a 2x4 joist tamped to an even bearing and grade given by said engineer, and suitable connections made with a sewer, or otherwise, as said engineer may direct.

The joints to be set one-fourth inch apart, covered with paper, to be selected by said engineer, and filled round four inches, at least, with coarse gravel, with the sand screened out, or coal cinders, with the ashes screened out, or other suitable material to be designated by said engineer, and the earth, excavated, so returned to the trenches, puddled and rammed, as to prevent any settlement thereafter.



CURBING.

Curb-stone shall be set along the outside line of the pavement on each side thereof, except at the crossings of streets, avenues and alleys, and shall be sound and durable stone, to be approved by the engineer, samples of which shall be furnished by contractor, and all curb-stone not equal to sample shall be rejected by said engineer. The curb-stone must be free from cracks or sand-pockets, straight, five inches thick when dressed, and not less than five feet in length on an average, and no piece less than three feet in length, except to complete a line of curbing, and eighteen to twenty-four inches deep; the top and front face down to the bottom of the paving shall be dressed to a true surface, and the back made substantially parallel with the front; the ends shall be dressed so as to make close joints three inches deep on the top, and on the face down to the bottom of the paving.

The curb shall be set to exact lines and grades given by the engineer, in six inches of sand, on a solid foundation, and the filling back of the curb shall be finely broken stone, or sand, well rammed, for six inches in rear thereof, so as to hold the curb firmly in place, and good and suitable filling, approved by the engineer, shall be brought even, after settlement, with the top of the curb for two feet back.

The corners of the lines of curbing, at street or avenue intersections, shall be neatly curved (or angled, if the engineer so directs) and substantially and firmly set, and where catch-basins are located, such openings and fitting to grates shall be made in the curbing as may be directed by said engineer.

The joints of the curbing to be made water-tight with Portland cement, mixed one-third clean, sharp sand.

Brick curbing must be placed at the street, avenue and alley crossings, to hold the pavement in place, and shall consist of vitrified brick, 12 inches long by 3x4½ inches, of good and durable quality, approved by the engineer, and firmly set 3 inch surface towards the pavement, with top level with the pavement and extending 12 inches into the ground, and back filled with same material as adjoining street or alley, where the same is in a good passable condition, otherwise, with good and suitable material, sufficient to hold the brick firmly in place.

APPROACHES.

The approaches connecting the street or avenue paved with all intersecting streets, avenues and alleys, shall be graded as directed by the engineer, and the top layer of the grade shall be, at least, one foot in thickness of broken stone, and made secure from settling adjoining the pavement, except where such intersecting streets, avenues and alleys are paved, in which case the pavements shall be joined and completed as herein specified for new pavement.

SUB-GRADE.

The street or avenue, within the district, shall be graded to conform to the grade as given by the engineer, and after being leveled to an even surface, thoroughly compacted by puddling and rolling with a heavy iron road roller, propelled by steam or horse-power, and heavier than any load said street or avenue will be required to carry, and weighing not less than —— tons to the foot in width, and ramming with a heavy iron rammer, weighing not less than 75 pounds, where the roller can not be used, especially along the gutters, to the satisfaction of said engineer. If horse-power is used, a sufficient number of horses must be employed to carry the roller steadily and guard against loosening up the filling with their hoofs.

The filling shall be of rock, broken into pieces not exceeding three inches in diameter, longest way, filled with sand, or of sand, gravel or earth, free from any animal or vegetable matter, or clay or perishable material, and shall be put on in layers of such thickness, not exceeding six inches where horse-power is used, as may be required by the engineer, leveled, puddled, rolled and rammed as above, and all the depressions filled and re-rolled or tamped, so that the outline of the sub-grade shall be smooth and even, and conform to the outline of the pavement when completed, and be compact and secure from settling, and be brought within a suitable distance from the top of the pavement when completed, according to the number of the courses of brick to be used.

When a cut is to be made, the street shall not be disturbed by plowing below three inches above the required sub-grade, but shall be "skinned off" with pick and shovel to the required even surface

and shape, and made level, rolled and rammed, same as for filling, to the satisfaction of the engineer.

Material wet and unsuitable for a foundation, in the opinion of the engineer, must be removed from the street or avenue and replaced by material of the same character and quality as above specified for filling, and leveled and well compacted, as above required, all at the contract price for grading.

The cross-walks, at street crossings, shall be elevated two inches, crowned and made nearer on a level from gutter to center, so that the pavement at such places shall be safe and convenient for pedestrians, and such crossings connected with the gutters in the most approved manner, or as laid out and directed by the engineer.

ONE COURSE PAVEMENT.

A layer of sound, hard limestone, broken before brought onto the street or avenue, into pieces from one to three inches in diameter (longest way) and thoroughly mixed with coarse, clean sand, as put on, in the proportion of one cubic yard of sand to three of stone, so that all of the spaces in the stone shall be filled (more sand being added on top, if necessary), shall be placed evenly over and upon the sub-grade prepared as above specified.

The cross-walks, at street corners, shall be elevated two inches, crowned and connected with the gutters as above specified for sub-grade.

Water shall be used for flushing, and the sand thereby well washed into all the spaces between the stone, and said sand and stone thoroughly compacted and made solid by rolling with said iron roller, and by tamping with said iron tamper, where said roller can not be used, especially along the gutters.

All depressions appearing after such rolling and tamping, shall be filled with stone (made smaller, if necessary) and sand, and rolled and tamped until a hard, even surface, secure from settlement and of the shape desired for the pavement, is produced, and when more material is added after rolling and tamping, the old shall be loosened two inches down, to receive the new, and the whole re-rolled and tamped;

Or coarse gravel, with all vegetable matter screened out, and coarse sand substituted;

Or coal cinders, with the ashes screened out and such sand substituted, compacted by such rolling and ramming, as above specified, may be substituted for such stone and sand. If horse power is used for rolling, a sufficient number of horses must be employed as specified for sub-grade.

The thickness of said layer, when thus compacted, shall be not less than six inches.

Not less than half a block or whole intersection shall be thus prepared at one time, and the engineer given an opportunity to examine the same before it is covered with sand, and the contractor shall, at the request of said engineer, make such changes and additions as may be necessary to cause the same to conform to these specifications.

Two inches of clean, coarse sand, free from stone, coarse gravel or lumps, shall then be spread upon such layer and made even with a templet, and caused to conform in cross-section, to the plan of the pavement and stakes set by said engineer.

Lay one course of paving brick on this cushion of sand, thus made even and of the shape and form required for the pavement when completed; such brick to be laid in straight lines (the brick being assorted for that purpose, if necessary), closely and evenly, edgewise of the brick and crosswise of the street and avenue, and at right-angles with the curb line thereof (except at intersections of other streets or avenues, where said brick shall be laid on an angle of forty-five degrees, or as the engineer may direct), with the joints broken not less than two inches; but no pieces shall be used, except to break joints, in starting and closing a line of brick, and then not less than half a brick.

The cross-walks shall be elevated, crowned and connected with the gutters as specified for sub-grade.

Such curve or angle and fall shall be given to the street or avenue, from the center thereof to the gutter, and such grade and shape given to the gutters (which shall be laid to a true line at the curb) as the engineer may direct.*

[* The fall from center to gutter, in a street 50 feet wide, should be about 8 inches, but this, of course, should be varied, according to width of street and other circumstances, as directed by engineer.]

The engineer shall now inspect the brick laid in the pavement, and the contractor shall remove, at the request of the engineer, all brick not suitable for pavement and as required by these specifications and shall relay the required brick in place thereof.

Sufficient dry, medium fine, clean sand shall be swept into the joints or crevices between the brick, thus laid, to fill them about half full.

The brick shall then be tamped by turning thereon from gutter to gutter a two-inch plank (or three-inch, if the two-inch follows the depression), fourteen inches wide, about twenty feet long, and thoroughly tamping back and forth on said plank with a wooden or iron tamper of sufficient weight (not less than fifty pounds), until the unevenness is taken out. Especial care must be used to tamp the pavement along the gutters and places where the roller can not be used, beyond the possibility of a settlement.

The pavement shall then be rolled (not less than half a block or whole intersection at one time) with the iron roller, after filling joints or crevices with dry, clean sand, until well settled and made firm and secure from any further settlement, and to conform to the grade and crown or angle of the street or avenue.

The engineer shall then inspect the pavement, and the contractor shall make all such changes, in the material or workmanship, as may be required by the engineer, to cause said pavement (including curbing) to conform, substantially, to his contract and these specifications.

Finally, spread over such pavement about three-fourths of an inch of clean sand and leave it to be driven into the joints and crevices by travel. (This may be removed by the city after about six weeks, or at pleasure.)

TWO-COURSE PAVEMENT.

For a two-course pavement, prepare the sub-grade, including cross-walks, six-inch layer of broken stone, coarse gravel, or coal cinders, filled with coarse sand, and the two-inch cushion of coarse sand, as above specified for one-course pavement.

Then lay one course of paving brick on this cushion of sand, made even and of the form and shape, including cross-walks, required for one-course pavement, as above specified; the brick to be laid in straight lines, flatwise of the brick and lengthwise of the street or avenue, and parallel with the curb line, and in conformity with the profile and cross-section of the street or avenue; each line of brick breaking joints with the adjoining line, but no broken brick are to be used, except in starting or closing a line to break joints.

This course shall be well settled and evened by ramming, as specified for one-course pavement.

Dry, clean, coarse sand, free from lumps, stone or gravel, shall then be spread over this sub-pavement in a sufficient amount, after being swept in, to fill all the crevices between the brick and leave one inch of sand thereon, which shall be made even with a templet, and of the same shape and form, including cross-walks, required for the pavement when completed.

Then lay one course of paving brick on this cushion of sand, and fill, tamp, roll and finish up in all respects as specified for one-course pavement.

BRICK.

The size of the brick used, except for curbing, shall not be over 9 inches long, 4 inches wide and 2½ inches thick, nor less than 8 inches long, 4 inches wide and 2 inches thick.

The quality of the brick for the top course shall be as follows: They shall be straight, regular in size and shape; free from flaws, cracks, seams or breaks; made expressly for paving and burned to vitrifaction, and able to endure the tests hereinafter specified; but hard-burned brick, made expressly for paving and of the above description, except as to vitrifaction, may be accepted, if they will endure said tests.

The brick for top course shall endure the following tests:

The modulus of rupture for transverse strength must not be less than 1,600 pounds to the square inch (computed by the following formula: $W=\frac{2}{3}\frac{bd^2}{l}R$; brick tested on flat side; W=load, in pounds; b, d and l, the breadth, depth and length in inches; R, the modulus of rupture in pounds per square inch.)

The brick must not absorb more than two per cent. of their own weight of water.

Shall not contain lime more than — per cent., or such a quantity as to cause disintegration or cracking in ten days soaking in water.

And shall have the power to resist abrasion equal, at least, to the best Quincy granite or like grade of granite, when tested under the same conditions.

These tests will be made after the contract is let and the brick delivered on the street, from three or five samples selected at large by the engineer, and the brick must **average** as above; but a variation of not over 20 per cent. in transverse strength and abrasion may be allowed.

For the sub-pavement, in two-course pavement, the modulus of rupture shall not be less than 1,000 pounds to the square inch; absorption, not more than 6 per cent.; lime, not in excess of requirements for top course, and loss by abrasion not over six times that of Quincy granite.

GENERAL SPECIFICATIONS.

First-class work, both in respect to its material and workmanship, will be required by the city of ———— to be done under the contract, and that the contractor shall furnish suitable tools and employ competent labor to perform the work to be done, and any labor or tools that shall not meet the approval of the engineer, may be ordered from the work by him, and such labor and tools substituted as shall meet his approval. All materials used in the work that may not, in the opinion of the engineer, be equal to the requirements of the specifications, shall be rejected by him, and such rejected materials shall be immediately removed from the line of the work. If any imperfect material shall have been put into the work, or poor workmanship shall have occurred in its prosecution, the same shall be replaced by suitable material or workmanship by the contractor at his own expense at any time prior to the final acceptance of the work.

Notice of any imperfection in the work to any foreman in charge of any portion of the work during the absence of the contractor, shall constitute notice to the contractor.

If the contractor or his employes fail to comply with any portion of these specifications, the engineer is authorized to employ sufficient labor and furnish sufficient materials to have the required work done, and deduct the cost from any money due, or that may become due, the contractor on account of the work, and if not enough is due, or will become due, to pay the same, said contractor and his bondsmen shall be personally liable therefor, and pay the same to said city, and said city may take possession of any tools, machinery and materials brought into said city by said contractor, and use the same in completing the work, and for that purpose shall have a lien and claim thereon, and shall be entitled to the possession of such tools, machinery and materials so brought into said city, to the exclusion of all other persons.

All material to be removed from the streets is the property of the city, and shall be delivered and placed upon the adjoining streets and avenues in such places as may be directed by the engineer, when not required for the filling of the street to be paved; but in case the haul shall exceed twelve hundred (1200) feet, the excess of twelve hundred feet shall be paid for by the city, at the rate of one cent per cubic yard for each one hundred feet more than the twelve hundred feet; but material taken from one part of a district to another part, or from one district to another, and used in grading, shall be included but once in computing the amount of grading.

The sub-grade shall include all the work and material, except curbing, required to prepare the street or avenue to receive the first dressing of sand, and shall be included in the grading.

The paving shall include all the material and labor required above the sub-grade, except curbing.

The curbing shall include the curb-stone, setting and back filling, and moving sidewalks when necessary.

No more than two blocks in length of the street shall be torn up, nor more than one cross-street be closed at any one time, unless by consent of said engineer.

In case of any detention in the progress of the work, not caused by the fault or negligence of the contractor, so that the work in the contract can not be completed within the time specified therein, the city council may grant such further extension of time as may be necessary and just, but no claim for damages on account of detention by the city from unforseen obstacles shall be allowed.

Red lights must be put up at night by the contractor, and he must maintain suitable barricades, and take all other and proper precautions to guard against damage or injury to property or persons, and interfere as little as possible with the use of the streets and avenues.

The grading and paving shall include that part of the street and avenue occupied by street railways and railways, unless such street railways and railways shall have graded and paved the same as required by the city, within the time required by said city.

The contractor must furnish samples of the materials which he proposes to use; and as to brick, at least ten days before the time fixed for opening bids, but the city council may admit samples furnished later, in their discretion. All samples will be kept as a standard (except that brick which will not endure the tests hereinbefore specified shall not be binding upon the city, as a standard in any case), and all materials inferior to them in quality will be rejected.

The contractor shall not assign this contract, nor any moneys due, or to become due, on account of work done under this contract, or sub-let any portion of the work to be done, without the consent of said city council.

The city may pay for the labor employed by the contractor, or the materials furnished, if deemed advisable, and the amounts so paid shall be deducted from the sum due or to become due upon the completion of the contract.

The city council may retain the whole or so much of the moneys due or to become due any contractor as shall be considered necessary until all suits or claims for damages, or on any account, aforesaid, have been settled and satisfactory evidence to that effect furnished the city council.

The contractor assumes all risk of variance in the statement of approximate amounts or quantities necessary to complete the work required by his contract, of which these specifications are a part, and agrees to do the same for the price bid.

Bidders must examine and judge for themselves as to the proposed work; the nature of the excavation to be made and the work to be done, and they assume all risk and responsibility for and on account of damage to the work, or loss or injury to the property, or material on the line of the work.

The contractor must not disturb any stakes or monuments along the line of improvement, until directed by the engineer.

The contractor will be required to move all side-walks in the way of said improvements in a careful manner, in setting and resetting and backfilling curb-stones, and place the same in as good condition as found, and to the proper grade, and all cutting and resetting of curbing, and replacing of paving, shall be done as shall be necessary to make proper connections with work already done on adjoining streets and avenues.

No bills or claims for any additional work, beyond the contract price, will be allowed by the city, unless ordered in writing by the city engineer, under the direction of the city council of the city. In case of any dispute as to the nature of the work, or the requirements of the specifications, the contractor must, within five days, file with the city auditor of said city, a written statement of his claim, or no compensation will be allowed by the city council on account of any delay, trouble or additional work.

The inspections and oversight, by the engineer, shall not constitute an acceptance of the work and materials, or any part thereof, to be furnished by the contractor, but such acceptance shall be made only by the engineer and the city council upon substantial and final completion thereof as required by the contract and these specifications.

Before the final estimate shall be allowed and paid, the contractor will be required to sign a certificate on said estimate that he will accept the same as a settlement in full for all claims against the city of ———, on account of work done under his contract.

The contractor shall pay to the city of ——— or any other artificial or natural person all damages, losses, costs and expenses together with interest thereon, which the city or such person shall sustain or be subjected to, by reason of any failure, fault or neglect, in any respect, of the contractor, his agents, servants or em-

ployes, in or during the progress of the work, in furnishing or maintaining suitable barriers and red lights; in furnishing material and labor, or suitable material and labor, and completing the entire work herein contemplated according to the contract and these specifications and in a first-class manner, or by reason of any tools, machinery, labor, material or property furnished for or on account of said work, and shall indemnify and save harmless the city and such person from any and all such damages, losses, costs and expenses and interest thereon; and in case any suit is brought against the city or any of its officers on any account hereinbefore specified, said contractor shall defend the city at his own expense and pay all judgments and costs which may be obtained against said city with interest thereon.

The term "city engineer" or "engineer," as used herein, shall apply to his assistant, or to any person authorized by the city of ——— to act as such engineer or discharge the duties of engineer in regard to the work contracted for.

In the interpretation of these specifications the decision of the engineer shall be final.

STATE OF———)
COUNTY OF———} ss.
CITY OF———)

I hereby certify that the foregoing specifications for grading, curbing, guttering and paving Improvement District No. — in the city of ——— were prepared by me under and by virtue of a resolution of the city council of said city, adopted on the ——— day of ———, 189—.

——— ———,
City engineer of the city of ———.

INSTRUCTIONS TO BIDDERS.

Each number of the "proposals" should commence with "I" or "We," as the case may require.

Bidders must bid for the work in each improvement district separately, and may bid for all the districts combined.

The cost of paving a space seven feet wide along the line of railways and street railways is assessable to such railways, and due in sixty days from date of levy of tax, bearing seven per cent. interest from such date, and the levy is made upon the completion of the work, and such cost is a lien on the property of such railways, which is security for payment.

The cost of paving intersections of streets and spaces opposite alleys and city property is paid by "city improvement bonds," due in twenty years, but payable any time after ten years, bearing five per cent. interest, payable semi-annually, a tax being required to be levied annually to provide a fund for payment of such bonds and interest, which can not be applied to any other purpose.

One-fifth of the cost of paving opposite private property is payable in cash in ninety days from levy of tax, as above stated, with six per cent. interest from levy; the balance in two, four, six and eight years, with such interest, and all is a lien on such property; and for which "improvement bonds" are issued, due at the same time, with same interest, payable annually, and the tax thus due from private property must be applied solely to the payment of said bonds and interest.

Bidders who will accept cash only, and will not accept bonds to the extent indicated, should cross out No. 2.

They should sign the bids with firm name (if a firm), and each individual member of the firm should sign his full name also; if not a firm, the full name should be signed, and the P. O. address of the signers should be added in all cases.

The bid should be sealed up and addressed to "the city auditor," ....., ..., and indorsed across the end of the outside of the envelope, "Proposals for grading and paving District No..... ....., in the city of ....., by..... ....., and each bidder should accompany his bid, in a separate envelope, by a money deposit of $500, or a bond equal to ten per cent. of the amount of the work computed on the engineer's estimate of "approximate quantities" at the price bid, to enter into a contract, if the bid is accepted and indorsed, "Bond to enter into contract," by.....

APPROXIMATE QUANTITIES IN EACH DISTRICT.

District No.....Lineal feet of tiling.....
Cubic yards of grading.....
Lineal feet of stone curbing.....
Lineal feet of brick curbing.....
Square yards of brick paving.....

District No.....Lineal feet of tiling.....
Cubic yards of grading.....
Lineal feet of stone curbing.....
Lineal feet of brick curbing.....
Square yards of brick paving.....

District No.....Lineal feet of tiling.....
Cubic yards of grading.....
Lineal feet of stone curbing.....
Lineal feet of brick curbing.....
Square yards of brick paving.....

For further instructions and information, bidders are referred to the ordinances and resolutions of said city, notice to contractors, and plans and specifications of the city engineer, copies of which will be furnished by the city auditor on application.

PROPOSALS.

For furnishing the materials and doing the work of tiling, grading, curbing, guttering and paving Improvement District No. ——, in the City of———, State of ———, according to the ordinances, resolutions, notice and plans and specifications, under and by which the work is to be done, and to the satisfaction and acceptance of the city engineer and the city council of the city of ———, for the prices hereinafter specified for the work indicated.

To the City Council of the City of .....

No. 1. * IMPROVEMENT DISTRICT, No.....

.... will do the tiling for.....cents per lineal foot.
.... will do the excavating and grading for....cents per cubic yard.
The curbing with stone 18 inches wide, including setting and back filling for.....cents per lineal foot.
The same, 24 inches wide, for.....cents per lineal foot.
The brick curbing at intersections for.....cents per lineal foot.
The paving with one course of brick as specified for "One-Course Pavement" for $....per square yard.
The paving with two courses of brick as specified for "Two-Course Pavement" for $.....per square yard.

No. 2.

The above bids are made on a cash basis, but .... will accept in payment the first installment of the amount assessed to abutting property and the amount assessed to railways and street railways as collected, and "city improvement bonds" and "improvement bonds" as cash for the balance of the aggregate that may become due for the entire work.

Dated..... 189..

(Full name of all parties).....
.....
.....

(P. O. Address).....

NOTE.—The foregoing are the latest specifications for paving in Clinton, Iowa, though adapted to any locality, and in accordance with which a large amount of paving has just been ordered and to which a larger amount will soon be added. After having tried brick pavements for three years, the people demand more, at their own expense, faster than the city can furnish it.

*The above form of bid must be repeated for each Improvement District.

COUNTRY ROADS.

IT has been said, and truly, too, that good farms will raise good fences and farm buildings as well as good crops; but, paradoxical as it is, the very worst roads are to be found in passing through the finest and most productive agricultural sections of the United States. So potent is this evil that a few weeks ago I was driving across the country with a gentleman looking for a fine farm with a view of purchasing a country home. Driving over a fine road he would make no inquiries, claiming that good farms were rarely found in the neighborhood of good roads—a sad comment, indeed, on the forethought and economical attributes of the farmers generally.

Nothing adds more to the beauty and appearance of a country than good roads. Nothing lessens the bills for blacksmithing, horse doctoring and general repairing so much as good roads; nevertheless road making, as generally understood in most sections of the country, seems to be but a united effort to evade the main issue and get rid of the poll-tax for the time being. Generally speaking, those who are entrusted with the superintendence of road making know as little of the science of the subject as they do of the man in the moon or of the agricultural products of Central Africa, and care a great deal less.

As a rule, our country roads are double the width necessary to accommodate the travel. They are usually sixty-six feet wide, while only twelve or fifteen feet are available for the purposes of travel. The rest, often valuable land, becomes a barren, weedy waste, a constant reminder of the shiftlessness and laziness of those having the matter in charge. No attempt is made to carry off the water, but the road bed is built up out of the water by scraping up the alluvial deposits in the ditches into the center, leaving on the sides deep gullies that are a menace to the loaded wagons turning out. These gullies during the spring and fall are filled with water, and in summer adorned with unsightly weeds, seeding and spreading over the adjoining fields. On the very apex of this ridge the driver carefully and painfully picks his way, skillfully avoiding the ditch on either side; for once in it, getting out again is a matter of time and strength of team, vehicle and gearing.

What we, as farmers, generally understand as improving a road consists in hauling a little more soil from the ditches and piling it up in the center of the roadway. When we have thus improved (?) the road it looks rather more like a garden bed than a highway. Our country roads are more than twice the width of English roads, but with us not more than one-fourth the space is fit for use, the rest being a delusion and a snare, while every part of the roads in England is available and is used.

The science of road making pre-supposes drainage as the primary requisite. It is much easier to make way for the water to run down hill than to pile up the earth until it reaches a line above high-water mark. The natural bed for a road is slightly different from what we would naturally select for a garden. Something that will not make mud during a wet season is wanted. Gravel or broken stone, one or the other of which is abundant, cheap and easy to get, should be used in road making if it can possibly be obtained, even at considerable trouble and expense. If good drainage is secured, and the proper material used, there is no necessity of having the roadway so rounding as to make it unpleasant for travel. Just sufficient fall to carry off the surface water is all that is necessary or profitable.

If a road is made very rounding, all teams are necessarily compelled to keep to the center, and it is soon worn into ruts, there being often but one track; but, if a road is made nearly flat, every foot is used. It wears evenly and no ruts are to be seen. Every inch of a road should be kept in perfect order, and if we can not afford to keep a road of sixty feet in good condition, let us be content with one of thirty or even twenty feet, and fortunately twenty feet is all that is needed on the most frequently traveled country roads. Twenty feet will allow two double teams to pass very easily on each side of a buggy standing in the center of the road. Such roads would look narrow and contracted; some might think they would disfigure the landscape. This, however, is a mistake, as those who have visited countries where such roads are the rule will testify.

A country road must be made by cheaper methods than the streets of our cities or the suburban avenues that extend from the city to the nabob's home in the country adjoining, and which for a mile or two are usually bordered by genteel residences; but where stone is abundant in the field, as is the case in a great many places, to the injury of the crops, detracting much from the beauty and tidiness of the place, it is much better to use them in making good and permanent roads than to allow them to remain scattered over the soil or gathered in gigantic heaps, as is too often seen, occupying land to no good purpose and furnishing a harbor for weeds and vermin, besides being so much in the way when mowing or tilling the field containing them.

Remove the dirt from the road bed to the depth of a foot. Fill the space with the stones from the field, cover these with a few inches of gravel or very coarse sand, and a perfect road is the result—a road that, with occasional dressings of gravel, is practically perpetual. Such a road will cost something,—often will cost like fury, but it is better to make a few rods each year than to waste labor in scraping dirt about as is seen in most places, and which amounts to nothing, aye, worse than nothing, except to work out the road tax. We make roads as we farm—we spread over too much superficial area. As a consequence the results are what the boys call "too thin."

There can be no question but that good roads will pay for the building. Have them narrower, fewer, and better. One little instance proves the reasonablness of this argument. Clark county, Indiana, is noted for its very poor country roads. A few years ago two towns were rivals; both were equally distant from a fine agricultural section. In order to get that inland trade one of them conceived the idea of building one mile of good road each year toward that section. After the first mile was built the town felt the impulse of increased trade, and three miles additional were built by private subscription. Travel and trade increased in proportion: the next year seven miles of new, good road appeared. To-day all the roads leading to the town are being made good ones, and if you are inland within three miles of the railroad and hire a man to take you to the station, he will drive the ten miles to Charleston for the sake of the good roads, and make better time with less wear and tear on horses, and wagon also. The other town did not improve the roads, did not get the trade, did not improve itself, and is dead. Yes, good roads do pay and pay well.—*Prof. E. L. Elsom in Prairie Farmer.*

MESQUITE BLOCK PAVING IN SAN ANTONIO, TEX.

By E. H. Converse.

IN pursuance of my promise, I will try to give you all particulars in regard to our mesquite block paving.

The mesquite is a native Texan wood and grows very thick, in the form of brush, throughout the entire southwest portion of Texas, and is a very tough, durable wood. The trees resemble any old peach trees in general appearance.

When the paving question was first agitated here, in 1888, of course, the first question that arose was, what material to use. There was no suitable stone in the vicinity. Paving brick was not then in the market here. Even building brick was shipped here from Laredo, though at present it is nearly all manufactured here. Asphalt would be a desirable paving here, not having any severe frost or icy streets. But the mesquite blocks were given the preference, with the idea of fostering a home industry. It is said that mesquite blocks have lasted for forty years in the city of Matamoras, Mexico, although we have no reliable information in regard to it.

Many think that this paving, as laid in San Antonio at the present time, will last fully twenty years, as a careful examination of the blocks that have been laid down two years, to date, show no perceptible signs of wearing.

The blocks are sawed to a uniform depth of (5) five inches, in a

hexagonal shape, the minimum diameter being (4) four inches and the maximum eight inches. The blocks are sawed with a slight batter, making the top about one-fourth of an inch smaller than the bottom.

First the roadway is excavated and rolled with Aveling road roller to the proper grade, and desired crown, then 4 or 6 inches of concrete, rammed flush, is spread over same. The blocks rest upon a sand cushion, one inch in depth, spread over the concrete wet. The older portion of the city is very irregular. It probably never was laid out. I think some of the streets must have happened, so to speak. No excessive grades were encountered, the greatest difficulty being in light grades, it being necessary to conform to the existing sidewalk elevations.

There has been expended in the past three years about $120,000 for this class of pavement. Among the streets so improved are the following:

Alamo Plaza, 8,741.58 square yards	$24,752 90
Main Plaza, 8,384 square yards	22,946 74
Commerce street, 5,544 square yards	18,897 56
Extension of Alamo Plaza, 3,399 square yards	10,182 65
Houston street, 9,950.7 square yards	31,800 89

There are other streets and plazas paved with the blocks to the extent of 384,473 square yards, amounting to $12,390.30, making a total of $120,971.05.

There is in contemplation about 10,000 square yards under the present contract. In conclusion, I can say that it is a very excellent pavement, durable, easy to keep clean, and agreeable to ride over.

PORTLAND CEMENT AS A SUBSTITUTE FOR STONE.

CEMENT is rapidly superseding the use of stone for all building purposes, as the advantages over the latter are various, inasmuch as it can be conformed to any shape or space, is readily transported, and almost as speedily constructed; the only great obstacle is quality, this being such an important feature that the strength of each barrel may in a measure determine the strength of that portion of the work where it is used. Ordinarily, where cement has a good reputation, and is used in large masses, as concrete in heavy foundations, etc., the testing of every tenth barrel would be sufficient; on the other hand, the common practice of making the price the leading feature necessitates the testing of samples from each barrel used.

The quality of the material to be compounded with the cement is of vital importance; the materials that give the best results are those that are hard and angular and perfectly free from dirt or earthy matter. The writer believes that crushed granite is likely to give the best results, as it presents a rigid surface and possesses a peculiar affinity for the cement mortar. Where sand is used it should be clear and sharp.

There are various methods and machinery for ascertaining the quality of cement, but it is not so simple an undertaking as it is sometimes thought to be; no small degree of experience is necessary before one can manipulate the materials so as to obtain approximately accurate results. The test for tensile strength on a sectional area of one square inch seems to be the best; where the bricquettes are small, there is less danger of air bubbles and the amount of material requisite is smaller. The tensile test, if properly made, is a good one, though not a perfect indication of the value. The time necessary for making this test is lengthy. For this reason short tests are made in cases of necessity; under the circumstances it would be well to introduce the tests for checking and for fineness. The strength of a cement depends greatly upon the fineness to which it is ground, especially when it is to be incorporated with a large amount of sand. Cement to be of the average fineness, that not more than ten per cent. should be rejected by a sieve of 2,500 meshes per square inch. The finer the cement, if otherwise good, the larger quantity of sand it will take, and the greater its value.

The test for cracking or checking, though simple, should not be omitted; make several cakes of neat cement three inches in diameter, from one-half to three-fourths inch in thickness; flatten out into thin edges; when hard enough put into water. These cakes should be carefully examined from day to day, to see if cracks show themselves at the edges; these cracks indicate that the cement is unfit for use at that age. These cracks may be caused by too much unslacked lime, and will disappear with age, the color being a substantial indication. One of the cakes can be kept in the air and its color observed, which should be uniform throughout; yellowish blotches indicate a poor quality. Portland cement should be of a bluish gray color.—*Warner H. Jenkins in the Builders' Magazine.*

ASPHALT PAVING IN CHICAGO.

ASPHALT paving seems to be growing in popularity in Chicago. At the beginning of the paving season the only thoroughfare of importance which was laid in asphalt was Ashland avenue. That was improved under the superintendence of the Park Commissioners. But recently the city authorities have taken kindly to the pavement, and contracts have been let for laying the following streets and avenues in asphalt: Monroe street, between Kedzie and Central Park avenues; Adams street, between Kedzie and Central Park avenues; Prairie avenue, between Twenty-sixth and Thirty-first streets; Walnut street, between Homan and Central Park avenues.

And in addition to this the council has ordered the paving of the following streets with asphalt:

Albany avenue, from Douglas boulevard to West Twelfth street; Bonney avenue, from Ogden to West Twenty-sixth street; Bonney avenue, from Ogden avenue to Douglas Park boulevard; Calumet avenue, from Thirty-ninth to Forty-second street; Calumet avenue, from Forty-third street to Fifty-first street; Ellis avenue, from Thirty-ninth street to Forty-third street; Elizabeth street, from West Madison street to West Randolph street; Millard avenue, from Ogden avenue to West Twelfth street; Ontario street, from North Clark street to St. Clair street; Ohio street, from North Clark street to St. Clair street; Robey street, from West Twelfth street to Douglas Park boulevard; West Congress street, from Ashland avenue to Ogden avenue; Warren avenue, from Leavitt street to Oakley avenue; West Jackson street, from Halstead street to Clinton street; Wabash avenue, from Twenty-second street to Thirty-fifth street; Wabash avenue, from Thirty-ninth street to Fifty-fifth street; Douglas Park place, from Fairview avenue to California avenue; Fulton street, from Homan avenue to Central Park avenue.

The contracts for most of those streets are to be let soon. In the case of Wabash avenue the contracts were about to be let when Alderman Woodward and Alderman Kinney presented their protest. Then supplemental ordinances were presented and the original ordinances were referred with them to the Committee on Streets and Alleys South. This will probably have the effect of deferring the improvement for a year.

The West Park Commissioners, it may be added, have contracted for an asphalt pavement on West Jackson street, from Halstead street to Garfield boulevard.—*Chicago Tribune.*

USE OF STREETS FOR ELECTRIC LINES.

UPON the principal residence street in Rochester they have an electric line running up one side of the street and down the other, between the curb and sidewalk. The space from the curb to the sidewalk is a well-kept lawn, undisturbed by the electric cars running over it, and one would never suspect that there were tracks in the grass until he got close to it or saw a car running over it. The poles are set on a line with the trees, which almost completely hides them, and have arms reaching out over the track to hold the trolley wire. The roadway is left clear for driving. The Board of Public Works of Indianapolis have decided to adopt this plan for future construction of street railway lines. Mr. M. M. Defrees says of it: "The first great advantange of such a plan is that it leaves the driveway clear. With double tracks in the center of the street and poles at short distances nobody will drive on the street if he can avoid it; it is dangerous and uncomfortable. The second point is in addition to the beauty of the street. The portion now occu-

pied by the tracks in the center of a street is a dead loss to everybody but the street railroad company, and is unsightly now, and will be more so when the rest of the roadway is paved and the space in the center left unimproved. If that useless space can be transferred to the sides and covered with green grass it becomes a thing of beauty instead of an eye-sore. The ordinary width of our residence streets is ninety feet between building lines; I think that is the width of Tennessee street. Now, suppose the sidewalks are six feet, and the roadway, which would be clear of tracks, should be made thirty feet wide. That would leave twenty-four feet of lawn on each side. Suppose the original lawn had occupied even as much as fifteen feet on each side. That would still leave nine feet of lawn on each side for the tracks to run over, which is ample room, without interfering to any appreciable extent with the shade trees. The drive-way is left clear and beautiful, as well as comfortable and convenient. There is ample room for a space of three feet between the track and the curb for hitching posts."

PUBLIC IMPROVEMENTS IN BURLINGTON, IA.

THE annual reports of the city officers of Burlington, Iowa, have been published in a pamphlet of fifty-five pages. Mr. William Steyh, the city engineer, shows in his report that during the last year the public work in Burlington comprised 18,875.3 feet of curbing, 46,212.2 square yards of brick paving, 1,476.3 square yards of lime-stone block paving, and 3,139 square yards of macadam, at a total cost of $94,222.03. The total number of square yards of the various pavements up to date is 333,132.5, of which 177,456.8 are macadam, 59,591.3 lime-stone block, 92,456.4 brick, 3,628 granite block. In miles it gives the following figures: Macadam, 7 80 100; brick, 3 75-100; lime stone block, 1 63-100, and granite, 11-100, making a total of 13 29-100 miles of paved streets and alleys. The total number of feet of curbing is 99,243.7, or 18 79-100 miles. During the year 5,265 feet of sewers, 18 man-holes and 33 catchbasins were constructed, at a total cost of $14,498.09. The total cost for the construction of sewers up to date is $154,020.60, exclusive of repairs, cleaning and inspection. In urging a better system of street cleaning in Burlington, Mr. Steyh says: "As to the cost of cleaning the streets with a sweeper I would state that in Peoria, Ill., they pay at the rate of 25 cents a block, which is less than it costs the city now to clean a single intersection with hoe and shovel. The streets, should, when possible, be swept at night and the dirt hauled away next morning. The purchase of a good street sweeper is strongly recommended." On the subject of improving roadways in and near the city he says, "A roadway 16 feet wide with an 8-inch foundation of large stone and four inches of broken stone on top would cost about $1.00 per lineal foot, which would make the assessment against each side about 25 cents per front foot, an amount which anyone ought to be willing to pay for the comfort he derives from an improved road, besides the smaller expense for wear and tear on vehicles and the opportunity of coming to the city in all seasons of the year."

DECISIONS AFFECTING PUBLIC WORK.

Liability of City for Change in Grade of Street.—A depreciation in the value of property abutting on a street, resulting from a change of its grade by the municipality, is not a taking of private property for public use, and hence, where the municipality acts under authority of law in changing the grade, and with due care, it is not liable for such depreciation, unless especially made so by the statute. (Smith *v.* City of Eau Claire, Sup. Ct. Wis., 47 N. W. Rep. 830.)

Liability of Contractor on Public Work.—Defendant had a contract to construct a sewer in the street of a city, in which the city reserved the right to "vary, extend or diminish the quantity of work during its progress." Before the work was completed he was directed to make certain changes in the grade of the sidewalk, which his workman did in such fashion as to leave a hole near the curb, into which the plaintiff fell and was injured. He was an independent contractor as to his work, and is liable for the negligence of his workmen therein. (Charlock *v.* Freel, Ct. of Appeals of N. Y., 26 N. Y. Rep. 262.)

TESTS OF PAVING BRICK.

A TEST of paving brick was made recently by the city civil engineer of Indianapolis, the specimens subjected to the test being from companies which are competing for contracts in Indianapolis. What are known as the abrasion and absorption tests were used. The results were as follows:

Absorption Test.—Central Clay Company, London mills, first; Indianapolis paving brick, second; Brazil block, third; John Porter brick, fourth; Ohio Valley Fire Clay Company, fifth; United States Fire Clay Company, Pittsburgh, sixth.

Abrasion Test.—John Porter brick, first; Ohio Valley Fire Clay Company, second; Brazil block, third; United States Fire Clay Company brick, fourth; Indianapolis paving brick, fifth; Central Clay Company, sixth.

ENGINEERING ASSOCIATION OF THE SOUTH.

TWO pamphlets have just been issued by the Engineering Association of the South, one of which, consisting of 50 pages, gives selections from papers read before the association during its fourth year, and the other presents a list of the officers and members of the association. The following are the subjects of the articles which appear in the pamphlet of selected papers: "The Slide Rule," by Edwin Thacker; "The Natches, Miss., Water Supply," by William L. Dudley; "The Louisville and Jeffersonville Bridge," R. L. Engle; "Test of the Holly-Gaskill Pumping Engine," Geo. Reyer, and "Coke-making in Western Kentucky," Jno. B. Atkinson. The pamphlet also contains the annual address of President MacLeod and a biographical sketch of Charles Lee Jungerman, who was killed while filling the position of city engineer of Newport, Ky.

A GREAT HELP.

To the Editor of Paving and Municipal Engineering:

SIR:—I must say that we find your paper a great help with regard to street improvements. Our town is just waking up with regard to street improvements, and the brick pavement seems to take the lead in popular favor. The city has let two contracts for paving, amounting to about 7,500 square yards, and the work is now under way. On the 23d of this month, at an election, it was voted to bond the city for $30,000, in addition to former contracts, for street paving or macadamizing. In addition we have established a sewer system which already amounts to about four and one-half miles, so that you see we are waking up.

J. L. RAYNARD, Street Commissioner.

Chillicothe, Mo., July 25, 1891.

A PINE BLOCK PAVEMENT IN MOBILE, ALA.

WE have received from Mobile, Ala., a sample pine block taken from the wood pavement on Royal street of that city, after having been in use for twenty-two years. Though badly worn on the surface end, the block is almost perfectly sound; and a piece of plank an inch and one-eighth in thickness, taken from under the block, being part of the foundation of the pavement, is apparently as sound as when put down.

THE STREETS OF COLUMBUS, O.

To the Editor of Paving and Municipal Engineering:

I QUOTE from your paving notes in issue for July, "Columbus, O., is paving a number of her streets with cedar blocks." Columbus is the best paved city in the United States, because she years ago discarded wooden blocks of all kinds and has miles of Hayden block, Hallwood block, asphalt and fire-clay brick streets.

Columbus, O., July 24, 1891. F. M. SENTER.

THE OLDEST ARTIFICIAL STONE WALK.

To the Editor of Paving and Municipal Engineering:

I WOULD be pleased to hear from you or some one of your contributors how old the oldest known artificial stone walk in this country is. I would like to have some accurate data upon that subject.

OTTO E. C. GUELICH.

Detroit, Mich.

Improvement and Contracting News.

PAVING.

Rochester, N. Y., will pave with Medina stone.

Lebanon, Pa., will pave with Belgian blocks.

Des Moines, Iowa, will have eight miles of paving.

Madison, Wis., wants paving and favors cedar blocks.

Hamilton, Ohio, will spend $10,000 on her streets.

Harrisburg, Pa., will pave State street with asphalt.

Norwalk, O., will have a new paving brick concern.

Erie, Pa., will pave several streets. Asphalt is preferred.

Davenport, Iowa, is doing considerable paving this season.

Norristown, Pa., desires to pave several streets of that city.

St. Louis, Mo., is doing extensive street paving this season.

Knoxville, Tenn., has appropriated $125,000 for street paving.

La Crosse, Wis., wants street paving, and favors vitrified brick.

St. Joseph, Mo., will do considerable paving with vitrified brick.

Sharon, O., will manufacture its own brick for paving streets.

Racine, Wis., will pave State street of that city in the near future.

Dubuque, Iowa, is considering the question of repaving Main street.

Fort Wayne, Ind., will pave East Berry street of that city with asphalt.

Plans are being completed for another $600,000 boulevard in Chicago.

Dubuque, Iowa, has decided to do extensive paving with vitrified brick.

Memphis, Tenn., will pave Second street of that city. Brick is preferred.

Hastings, Neb., wants several streets of that city paved, and favors brick.

Burlington, Iowa, will pave with brick, Fifth and Sixth streets of that city.

Muskegon, Mich., thinks she will shortly be manufacturing steel paving blocks.

New Milford, Conn., talks of macadamizing her roads to all adjoining towns.

Richmond, Ind., talks of paving Main street of that city with vitrified brick.

Cleveland, Ohio, will pave two or three more streets of that city with asphalt.

Oakland, Cal., wants Twelfth street of that city, paved with bitumen pavement.

Marquette, Mich., wants the principal streets of that city paved with cedar blocks.

Urbana, Ill., has decided to pave Main street of that city before the coming winter.

The mayor of the city of Alton, Ill., will receive proposals to furnish material and pave the following named streets with good No. 1 vitrified brick: Second street, Third street, State and Bell.

The question of paving the roadways of Huntington, Pa., with virified brick is being agitated.

Briston, Tenn., has voted to spend $100,000 a year for four years on the streets of that city.

Dunkirk, Ind., will pave Main street of that city with brick. Contract will be let August 27th.

Westchester, N. Y., is doing extensive paving this season; a number of contracts are yet to be let.

The Lexington, Ky., *Transcript* advocates the general adoption of concrete sidewalk paving in Lexington.

Oskaloosa, Iowa, has decided to invest $41,000 in paving some of her roadways with vitrified brick.

Sioux City, Iowa, will do extensive brick paving soon; about 13,000,000 bricks will be used for the purpose.

About $30,000 will be expended in San Bernardino, Cal., during the next few months, for street paving.

Work has just been begun on the first alley to be paved in Denver. It will be macadamized as an experiment.

West Superior, Wis., will pave Stinson avenue from West Second to West Nineteenth streets at a cost of $47,790.

Contracts have been let to the Barber Asphalt Company and the West Indies Paving Company for a vast amount of street paving in Denver, Col.

Proposals will be received by the city clerk of Norwalk, Ohio, at his office until August 31st, for the improvement of Linwood avenue, a distance of 938 feet.

Proposals will be received by the city clerk of Findlay, O., until August 30 for the paving of Allan avenue with first-class fire-clay brick, Hayden or Hallwood blocks.

The mayor of the city of Alton, Ill., will receive proposals until August 20 to furnish material and pave Second, Third, State and Belle streets with good No. 1 vitrified brick.

Proposals will be received by the board of public works of Omaha until August 21 for the following kinds of paving material: Sheet asphaltum, form "A"; Sioux Falls or other granite; white Colorado sandstone; vitrified or equally good brick.

Paving contracts have been let in Indianapolis by the board of public works as follows during the last month: Fulmer & Seibert, South Delaware street, 10,321 square yards, Ohio valley brick; Robert Kennington, Pearl street, 2,005 square yards, London mills brick; Minnehaha Granite Company, College avenue, 11,603 square yards, and South Meridian street, 7,960 square yards; Indianapolis Paving Company, College avenue, 11,070 square yards, Brazil brick; Fulmer & Seibert, Coburn street, London mills brick.

SEWERS.

Roanoke, Va., has voted $150,000 for sewers.

The city clerk will give details of proposed new $28,000 sewer on Worthington street, Springfield, Mass.

Spokane, Wash., wants a complete sewer system.

Lawrenceburg, O., wants a new sewer system.

Valparaiso, Ind., desires a system of sewerage.

Manchester, N. H., will spend $30,000 for new sewerage.

Paterson, N. J., will construct a number of sewers soon.

Grand Forks, N. D., will construct a $50,000 sewer system.

Several miles of sewers will be laid this season in Des Moines, Ia.

Meridian, Conn., is considering the adoption of a new sewerage system.

A sewerage system for the entire City of Mexico, Mex., is desired. Address Roberto Gayol, city engineer.

Tonawanda, N. Y., proposes to have a new sewerage system. President B. F. Felton will give details.

A survey has been taken of the public streets of Petersburg, Ill., with the view of putting in a sewerage system.

Alderman Sauders, Pawtuckett, R. I., also Mayor Doodwin, will give details of a proposed new plan of sewerage.

An ordinance providing for the construction of a sewer to the Iowa river has been passed at Marshalltown, Ia.

The board of public works, West Superior, Wis., has granted sewer estimates to the amount of $75,000, work to be done at once.

Geo. Wood, of the committee on sewers, Chester, Pa., has invited proposals for the construction of a new sewer on Fifteenth street.

The city clerk, Gloversville, N. Y., has invited bids for 4,600 feet of sewer pipe. Specifications of the new sewer can be had from F. H. Wilmarth, city clerk.

The board of supervisors, Denver, Col., has voted to authorize the board of public works to advertise for bids to construct storm sewers to connect with the Dalgany sewer, to cost $77,747.

The city of Springfield, Mo., is now prepared to receive bids for the construction of a system of public sewerage. Contractors will be supplied with information upon application to the city clerk.

Proposals will be received by Rollins Clark, city clerk of Keokuk, Iowa, until September 7th, for the construction of a three and a half foot brick sewer from Third and Palean to the Mississippi river, about 725 feet long.

The city of Freeport, Ill., contemplates putting in a complete system of sewers, covering the whole city, as soon as Mr. Arthur Lagron, C. E., is ready with the surveys, plans and profiles. Dr. J. F. Fair is the chairman of the sewer committee.

Proposals will be received at the office of the Board of Control, No. 5, City Hall, Cleveland, Ohio, until 12 o'clock August 26th, for the construction of sewers in the following named streets: Ridge avenue, Wade Park, Seymour avenue and Oakdale street.

WATER-WORKS.

Valparaiso, Ind., wants new water-works.

Tuscola, Ill., wants a system of water-works.

Mansfield, Pa., wants a system of water-works.

Breckenridge, N. Dak., wants water-works.

Waupaca, Wis., is to have a $60,000 water-works plant.

Kingsville, Mich., wants a system of water-works.

Pittsfield, Me., wants a system of water-works at once.

Nappanee, Ind., will have a $10,000 system of water-works.

Wellston, O., will adopt the stand-pipe system of water-works.

Dalles City, Ore., will spend $60,000 on a system of water-works.

Buchanan, Mich., will vote to bond the city for $50,000 for water-works.

Thirty-three miles of new water mains will be laid in Grand Rapids, Mich.

Dwight, Ill., has decided on putting in a system of water-works to cost $20,000.

Tawas City, Mich., has voted to raise $21,000 to put in a system of water-works.

Preparations are being made for an improved system of water-works for Aberdeen, Wash.

Washington, Iowa, has appropriated $40,000 for the erection of a system of water-works.

Wellston, Ohio, is to have water-works on the stand-pipe system, at an estimated cost of $61,550.

The contract has been let for the construction of water-works at Pontiac, Ill., to cost $50,000.

A franchise to construct water-works to cost $40,000 in Mount Vernon., Wash., has been applied for.

Romeo, Wis., has decided to issue bonds for $26,000 for the purpose of constructing a water-works system.

Alderman White, of the water committee, Meriden, Conn., will give details of a proposed increase in the water supply of that city.

New Britain, Conn., will improve her water system to the amount of $30,000 worth, for which it is proposed to issue bonds.

BRIDGES.

A new bridge will be built over Fox river, Princeton, Wis.

Spokane, Wash., proposes to build two new bridges over the river on Howard and Mill streets.

A new bridge will be built over the Tomahawk river, Tomahawk, Wis.

The Rothrock bridge over the Big Blue, at Leavenworth, Ind., has been crushed in.

Williamsburg, county-seat of Whitley county, Ky., will build five bridges in that county.

The board of supervisors, Lemars, Iowa, has decided to issue $12,000 in bonds to build bridges.

STREET LIGHTING.

Knightstown, Ind., is to have electric lights.

The electric light plant at New Albany, O., will be sold.

Wheeling, Va., has appropriated $100,000 for the purchase of an electric light plant.

Peru, Ind., has made arrangements for the introduction of an incandescent system of electric lighting.

Huntington, Ind., has purchased from the Fort Wayne Electric Light Company a fifty light incandescent plant.

Youngstown, O., will receive proposals for lighting that city, the contract to take effect on the 26th of next November.

PAVING BRICK NOTES.

New building and paving brick works will probably be built at Freeport, Ill.

R. B. Murdock, of Kansas City, Mo., will build the new paving brick plant at Sedalia, Mo.

The Olney Brick Paving and Tile Company, Olney, Ill., are in the market for new machinery.

The Colorado Fire Clay and Brick Manufacturing Company, of Pueblo, Colo., have perfected arrangements for the enlargement of their plant and the manufacture of all kinds of brick, and will soon put in a $5,000 brick press.

LITTLE WONDER!

The shops of the Wallace Manufacturing Company, at Frankfort, Ind., present a busy appearance.

The spacious buildings are crowded with machinery and mechanics, so that it seems impossible to wedge one's way through the establishment.

If, however, the visitor is fortunate enough to be shown through by the genial superintendent and manager, Mr. Cunningham, he not only moves with safety, but he hears with the keenest interest and sees with the utmost enjoyment.

The concern has just completed an outfit for the Des Moines Brick Manufacturing Company, of Des Moines, Iowa. It consists of a No. 3 open top Pug Mill, a Zenith Brick Machine, with Cunningham's Automatic Cutting Table. It has capacity of fifty thousand a day and will be used exclusively in the manufacture of paving brick.

A Little Wonder machine has just been shipped to the Washington Fire Clay Company, of Little Falls, Wash., and four tile plants have been sent out within the last few days.

The Zenith machine is of recent construction. It is a massive machine, containing features established by practical experience. A short examination of the Zenith dispels all thought of weakness in any part, and shows that it is not only a powerful but a thoroughly practical machine of very high grade.

By the time the round of the various shops is completed the visitor finds himself fired with Mr. Cunningham's earnest enthusiasm. He is strongly impressed with the merits of the Little Wonder, the Zenith and the Automatic Cutting Table; and if he knows the business methods of the Wallace Manufacturing Company he can easily understand why the business of the concern has trebled itself in the last five years.

WHERE LEADERS ARE MADE.

A visit was recently made by a representative of this publication to the new plant of The Decatur Leader Manufacturing Company, which is the outgrowth of The Brown-Frazier Manufacturing Company, of Portland, Ind., with additional capital and energy, with Davis Brown as president and general manager, Elmore R. Frazier, secretary, J. A. Dawson, treasurer, and the following board of directors: J. G. Shea, Samuel Diller, Davis Brown, J. A. Dawson and L. B. Casner. Their buildings are brick, of a substantial order and ample in dimensions, their tools and equipments all modern, and the workmen selected for their skill, knowledge and experience in this particular line of manufacture. This company is paying special attention to building the most simple, serviceable and convenient line of brick-making and clay-working machinery. Their machines are replete with conveniences big and little, that render them indispensable when once used, and contribute toward leaving a margin in the coffers at the end of a season's business. They are too numerous to mention all, but for illustration: a friction pulley on each brick machine that may be connected to suitable levers and operated from any desired point; an automatic cutting table that replaces its own broken wires without stopping and with little or no attention; both lubricating and dry dies, etc. They are adding two more brick machines to their line with capacities of 50,000 and 100,000 each per day. In these machines is embodied a principle never before introduced in the United States, as neither augers, plungers or cams are used to force the clay through the die. They have a crusher, pugger and molder, all combined in the simplest possible manner, occupying little room, each machine independent of the other so far as accessibility of individual parts is concerned, yet working together with harmony and precision. A series of experiments covering seven years by the designer, Mr. Davis Brown, together with data from England and Germany, where this principle has been used, precludes any possibility of failure. These machines will be protected by patents and ready for the market at an early day.

They are located near the center of population, and have railroad facilities for shipping in ten different directions. Patrons visiting their works can take West Main street cars from the union depot. Further particulars will be supplied by the company.

SEALED PROPOSALS.

TO CONTRACTORS.

Sealed proposals for construction of about 7,000 feet of 48 inch brick sewer and 1,200 feet of 48 inch iron pipe sewer, will be received by James M. Lambing, mayor of the city of Corry, Pa., until 7 o'clock P. M., Monday, August 17, 1891. For further particulars and specifications, address the Main Sewer Committee, or City Clerk, Corry, Pa.

M. M. RAYMOND,
JACOB FRANZ,
S. B. DUNHAM,
R. P. DAWSON,
Committee.

C. P. ROGERS, JR., City Clerk.

NOTICE TO SEWER CONTRACTORS.

Sealed proposals will be received by the common council of the city of Terre Haute, Ind., on Tuesday evening, September 1, 1891, for the construction of about 4,600 feet of brick sewer, varying in size from 2 feet 4 inches by 3 feet 6 inches to 3 feet 4 inches by 5 feet, and about 6,000 feet of pipe sewer, from 12 to 24 inches in diameter; 57 catch-basins, 19 man-holes, 16 lamp-holes, and out-fall at river. All proposals to be accompanied by a certified check in the sum of $2,000. The council reserves the right to reject any or all bids.

Plans and specifications on file in my office.

FRANK H. COOPER, City Engineer.

PROFESSIONAL CARDS.

The many letters constantly received asking for the names of persons who can give technical advice on municipal work must be answered by the publishers, by referring the writers to this list of competent and reliable Civil Engineers.

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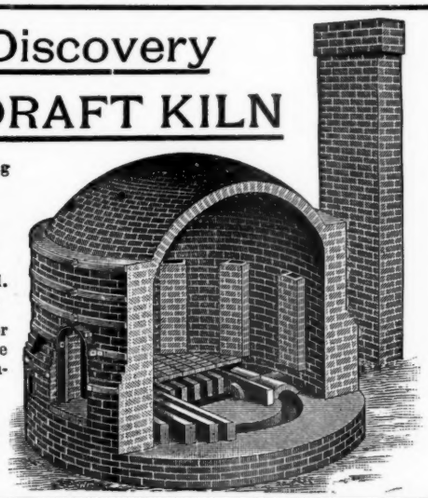

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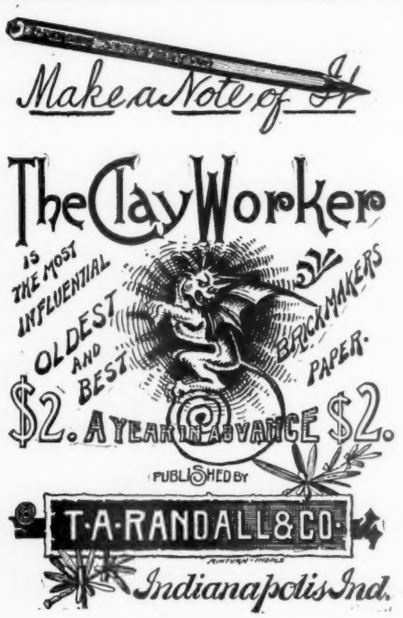

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LONDON, January 9, 1891. Yours faithfully, THE PATENT VICTORIA STONE CO., L'D.

To Messrs. Gibbs & Co., L'd. HARRY ROGERS, Manager and Sec'y.

Write for prices and all information to **HOWARD FLEMING, 23 Liberty St., New York, Sole Agent in the United States.**

THE PURINGTON PAVING BRICK COMPANY

OF GALESBURG, ILLINOIS,

Is now operating one of the most extensive and best equipped plants ever established for the manufacture of Paving Bricks.

Mr. D. V. Purington, of Chicago, the President of the Company, is one of the foremost brick makers in the country.

In less than ten years he has ordered and put into operation **ten Chambers Brick Machines,** and with this practical knowledge of their merits his Company at Galesburg uses

THE CHAMBERS BRICK MACHINES,

CHAMBERS HORIZONTAL PUG-MILL,

CHAMBERS WROUGHT BODY DRYER CARS.

IT PAYS TO BUY THE BEST. FOR ADVERTISEMENT CHAMBERS' MACHINERY, SEE LAST PAGE OF COVER.

FOR MAKING ROAD METAL USE THE

GATES ROCK AND ORE BREAKER

OVER **2000** IN USE.

CAPACITY IN TONS OF 2,000 POUNDS.

Size 0	2 to 4 tons per hour.	Size 4	15 to 30 tons per hour.
Size 1	4 to 8 tons per hour.	Size 5	25 to 40 tons per hour.
Size 2	6 to 12 tons per hour.	Size 6	30 to 60 tons per hour.
Size 3	10 to 20 tons per hour.	Size 7	40 to 75 tons per hour.
		Size 8	100 to 150 tons per hour.

Passing 2 1-2 in. ring, according to character and hardness of metal.

Great Saving in Power. Adjustable to any Degree of Fineness. The principle involved in this Breaker acknowledged to be the greatest success ever introduced into Stonebreaking machinery. The Gates Breaker has made more railroad ballast and road metal than all other kinds of breakers combined. **Universally Adopted by Mining Companies. Many Hundreds Used by Railway Companies.** Will furnish a thousand references from Contractors, Street Superintendents, Mines, Cement Manufacturers, etc. Also Manufacture

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Fine Crushing Plants, Concentrators and Other Mining Machinery. Address for Catalogue

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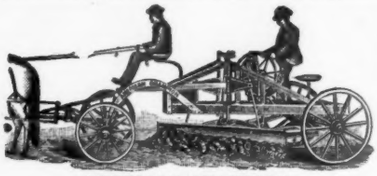

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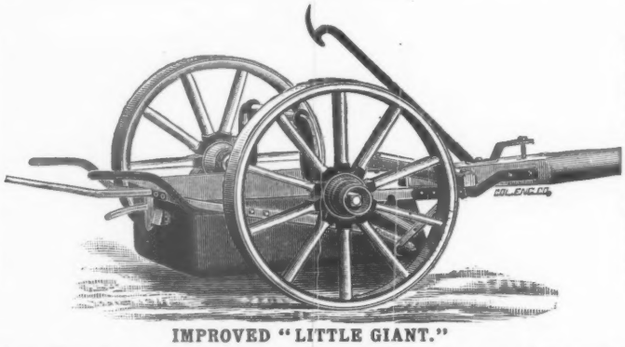
Road and Street Working Implements Of All Kinds.

LIGHT STEEL CHAMPION.

THE CHAMPION ROAD MACHINES, as illustrated above, not only have the reputation which entitles them to be called the BEST on the market, but they have the merit. Merit wins in all lines of goods, and never has this fact been more fully demonstrated than in the production of the Champion Machines. They are built thoroughly and of the best material, and combine all of the latest and best improvements known to modern road machines.

They are used and endorsed by the highest authorities on Road Making, and are shipped on trial, thus affording the purchaser an opportunity to judge of their merit before accepting them.

WE ARE PREPARED TO FURNISH AT BOTTOM PRICES ANY IMPLEMENT USED IN ROAD OR STREET BUILDING.



IMPROVED "LITTLE GIANT."

WE SOLICIT YOUR TRADE ON THE BASIS OF FAIR DEALINGS AND GOOD GOODS AT HONEST PRICES.

What has been said of our Road Machines with reference to merit is also applicable in the truest sense of the word to our Wheel and Drag Scrapers.

To those who have become acquainted with the merits and advantages of the old "Little Giant," we would say, the Improved "Little Giant" or No. 1 Wheel Scraper is far superior to it, and the best wheeled Scraper on the market.

STEEL SCRAPER.

Its improvements consist in our New Patent Automatic Dumping Hooks, Independent Steel Axle, Bifurcated Compound Lever and large Steel Bowl.

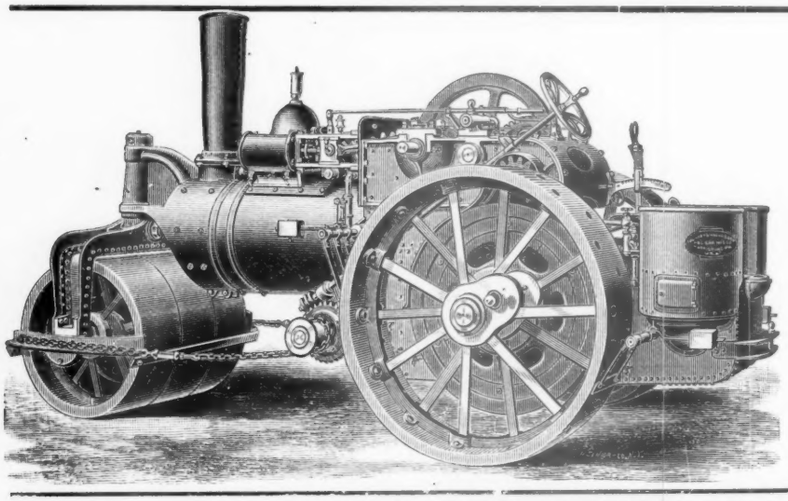
Our "Solid Steel Scrapers" will work easily in any soil, whether plowed or not, and are guaranteed to work easier and clean better than any other Scraper on the market.

In connection with the above, we manufacture the Champion Road Roller and the Champion Steel Rock Crusher.

Write for prices and illustrated catalogue, representing the largest line of Road Working and Earth Handling Implements on the market.

STEEL SCRAPER.

American Road Machine Co., Kennett Square, Pa.



THE HARRISBURG PATENT

DOUBLE ENGINE STEEL

Steam Road Roller

Constructed of the Best Quality of Material Throughout Guaranteed Equal to any

ROLLER IN THE MARKET.

MANUFACTURED BY

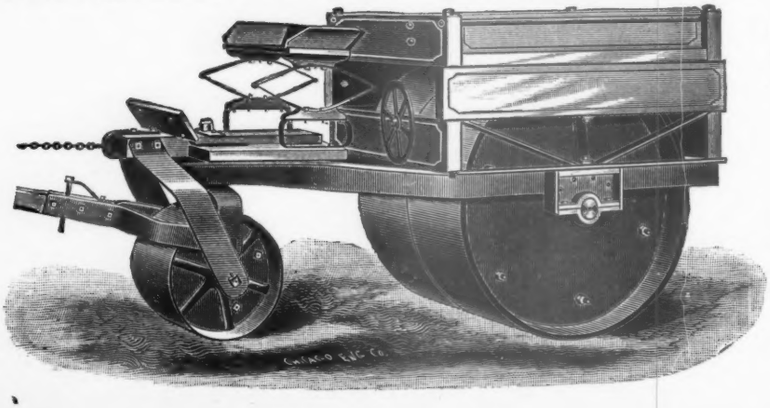
HARRISBURG FOUNDRY AND MACHINE WORKS,

Successors to Foundry and Machine Dept. of the Harrisburg Car Mfg. Co.,

HARRISBURG, PA.

SEND FOR CATALOGUE.

ROLLER FOR STREET PAVING



This Roller fills a long-felt want, as many contractors are not justified in purchasing an expensive Steam Roller, nor can afford to shift with a crude or inferior machine not capable of doing good work. Write for description and prices, also for prices on Street-crossing Plates. Address

ENTERPRISE MANUFACTURING CO., COLUMBIANA, OHIO.

STEUBENVILLE, OHIO, February 17, 1891.

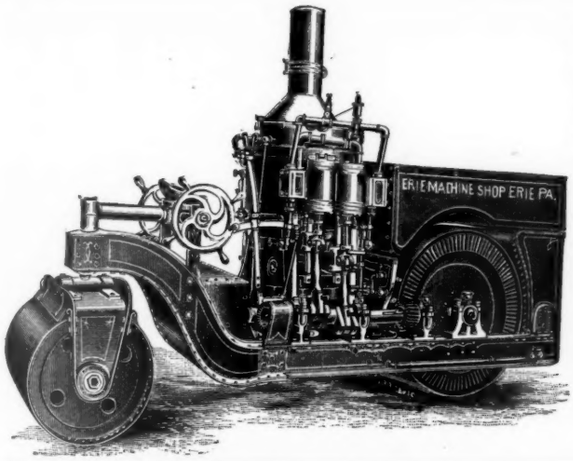
GENTLEMEN—We have been using the two Rollers on street gravel; also on almost eight miles of crush stone Macadam turnpike, rolling the layers of broken stone. It works to perfection. We find the brake (lock) a great convenience on hills and moving, and for short turns it beats the world. Four horses will handle on ordinary hill grades and two on the level.

Yours truly, A. W. McDONALD.

NEW CASTLE, PA., June 3, 1891.

GENTS—Your Roller was tested to the capacity authorized, viz.: seven ton, and stood the test very satisfactorily. We are so far very well pleased with it. Your bill was approved and payment ordered. Very truly yours, J. H. MILLER,

City Engineer.



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MANUFACTURERS OF

Steam Rollers

Corner Twelfth and State Streets,

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The principal Asphalt Paving Companies in the country are using these machines, which are pronounced to be the best in the market.

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Patent Portfolio Scrap-Book

A SCRAP-BOOK WITHOUT PASTE.

The old-fashioned Scrap-book has leaves on which scraps are pasted, as collected, without orderly arrangement. Breed's Scrap-Book has pockets, or envelopes, into which scraps are dropped and methodically filed by subjects. There is no pasting, no annoyance, no loss of time, no dirt! The subject is written on the envelope containing it and entered in the index. No matter how many scraps have accumulated, all upon the same subject are together and can be easily removed, consulted and replaced. Scraps kept in this book are not blurred by pasting, defaced by exposure or mutilated by removal. Notes for editorials, sermons, lectures and other addresses can be filed here, and a record of time and place of delivery be written on the envelope. As a receptable for scraps, papers and writings, *methodically arranged for convenient reference*, it has no equal. It contains fifty heavy manila envelopes, with tuck, 6x9 inches in size, handsomely bound together in a book that stands upon an ordinary book-shelf. Half Amer. Russia, cloth sides. Price, post-paid, $3 net.

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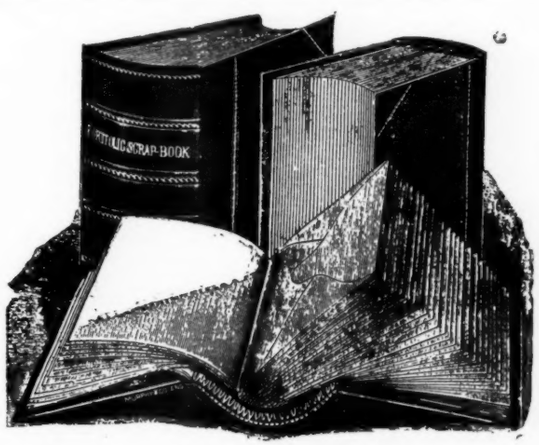


The Indianapolis Paving Exposition

Embracing the Largest and Finest Collection of Specimens of Paving in the World, will, on account of its value and beneficial influence in stimulating a spirit of public improvement, be continued indefinitely under the management of the Commercial Club of Indianapolis, the organization which originated the idea and made the Exposition a success. **Exhibits of more than sixty of the Leading American Paving Companies.** New exhibits are being added, and the Exposition will be enlarged and improved in every way possible. Companies not already represented are invited to send exhibits, but no paving material regarded by the committee in charge as being without merit will be admitted to the Exposition. Exhibits must, in all cases, be shipped with freight charges prepaid. The assurance can be given that more can be learned about paving at this Exposition than by visiting a dozen of the best paved cities in America.

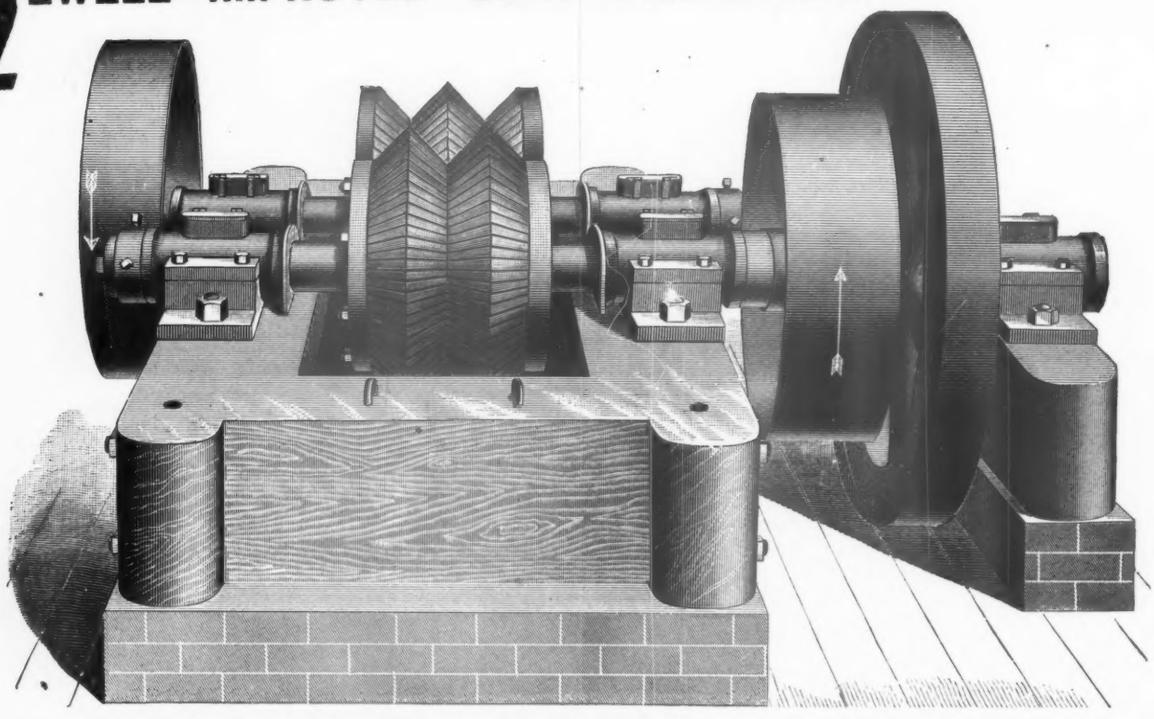
ALL cities in the United States are invited to send committees or official delegations to Indianapolis to avail themselves of the unequaled advantages afforded by the Exposition for GATHERING KNOWLEDGE OF PAVING. ◆ ◆ ◆ ◆ ◆ ◆

A TWO-CENT STAMP SHOULD BE SENT with requests for COPIES OF THE REPORT OF THE PAVING EXPOSITION.

FOR FURTHER INFORMATION, ADDRESS THE COMMERCIAL CLUB, INDIANAPOLIS, INDIANA.

M. S. HUEY, GEO. N. CATTERSON, WILLIAM C. BOBBS, Paving Exposition Committee.

NEWELL · IMPROVED · CLAY · PULVERIZER



Heavy Cold Rolled Shafts, Running in Best Anti-Friction Metal, Bearings Protected from Dirt.

OUR CLAY PULVERIZER grinds and prepares all clays used for manufacturing purposes thoroughly and economically, and is the only Mill in the market that will crush successfully, clay containing stones, clay dogs, sulphur balls, and other foreign substances, thus enabling manufacturers to make a first-class brick, and saving the wastage of brick where these foreign substances are not ground. We also manufacture special Mills that thoroughly crush slate, which is being largely used for brick making. CORRESPONDENCE SOLICITED.

NEWELL UNIVERSAL MILL CO. Electrical Exchange Building, 136 Liberty St., N. Y.

THE ✿ No. ✿ 10 ✿ BRICK ✿ MACHINE

UNEQUALLED FOR MAKING PAVERS • FOR SIDE CUT OR END CUT BRICK

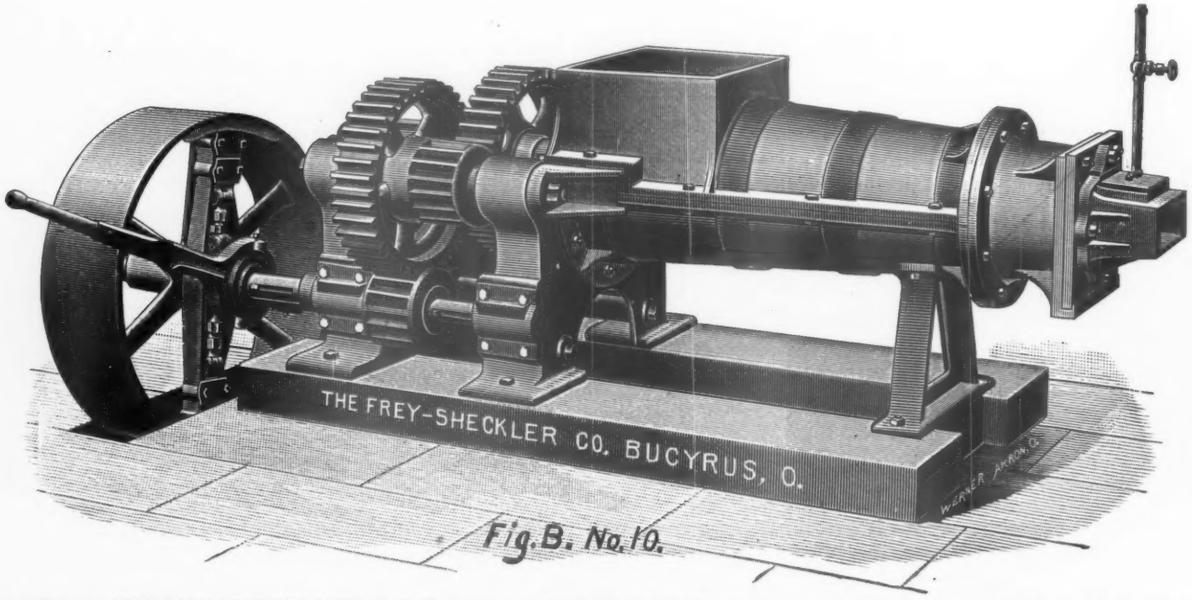


Fig. B. No. 10.

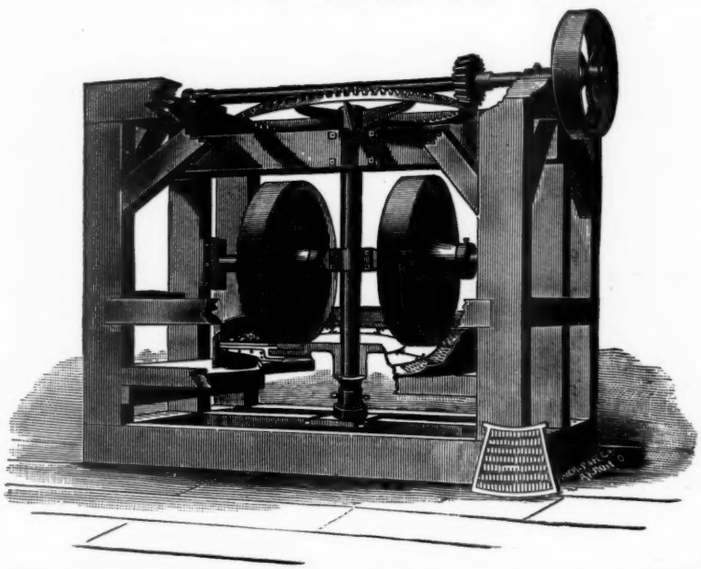
It makes, with our PATENT LUBRICATING DIE, handsome SOLID BRICK with full square corners, straight edges and smooth surface

SEND FOR CATALOGUE TO **The Frey-Sheckler Company**

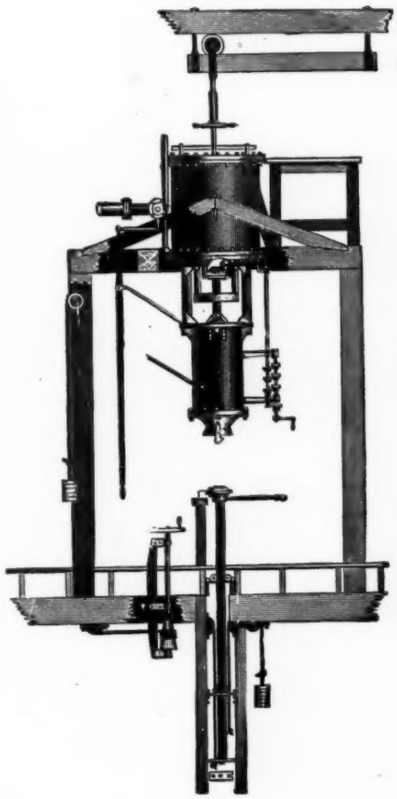
MANUFACTURERS OF CLAY-WORKING MACHINERY, BUCYRUS, OHIO, U. S. A.

Taplin, Rice & Co.

MANUFACTURERS OF IMPROVED CLAY-WORKING MACHINERY OF ALL KINDS, SUCH AS CLAY MILLS, DRY AND WET PANS, THE BARBER STEAM SEWER PIPE PRESS, DIES, CLAY BLOCKERS, POTTERS' WHEELS AND MACHINERY OF EVERY DESCRIPTION. WRITE FOR CATALOGUE AND PRICES. PROMPT ATTENTION AND DISPATCH GIVEN TO ORDERS.



AKRON
OHIO



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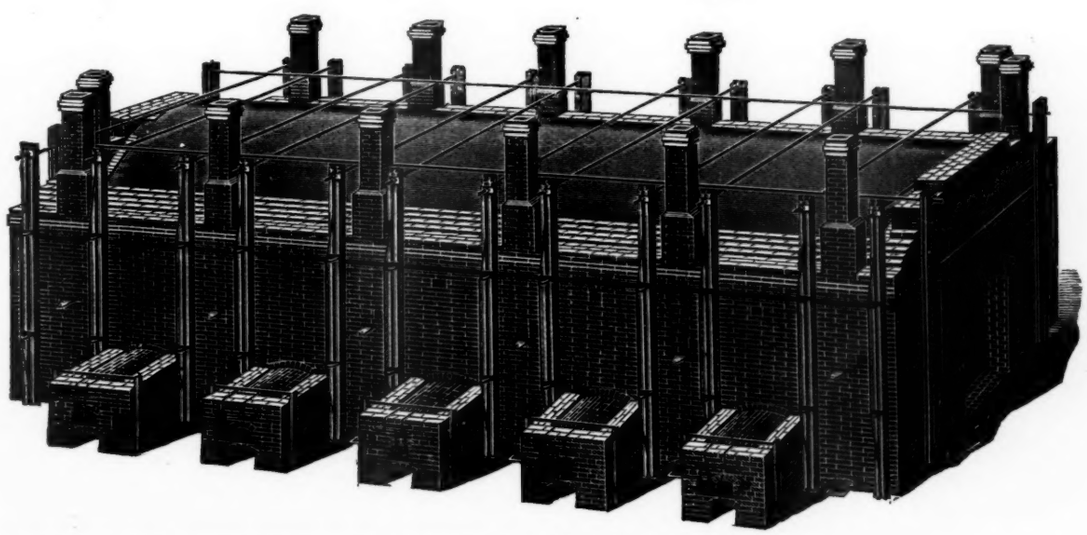
The Eudaly Kiln



Is No Longer an Experiment. Burns All Hard

This kiln is used by a majority of the largest STREET PAVING BRICK PLANTS in the country. It has no superior for FINE PRESSED OR FRONT BRICK. For further particulars

Address W. A. EUDALY, 64 Johnston's Buildings, Cincinnati, O.

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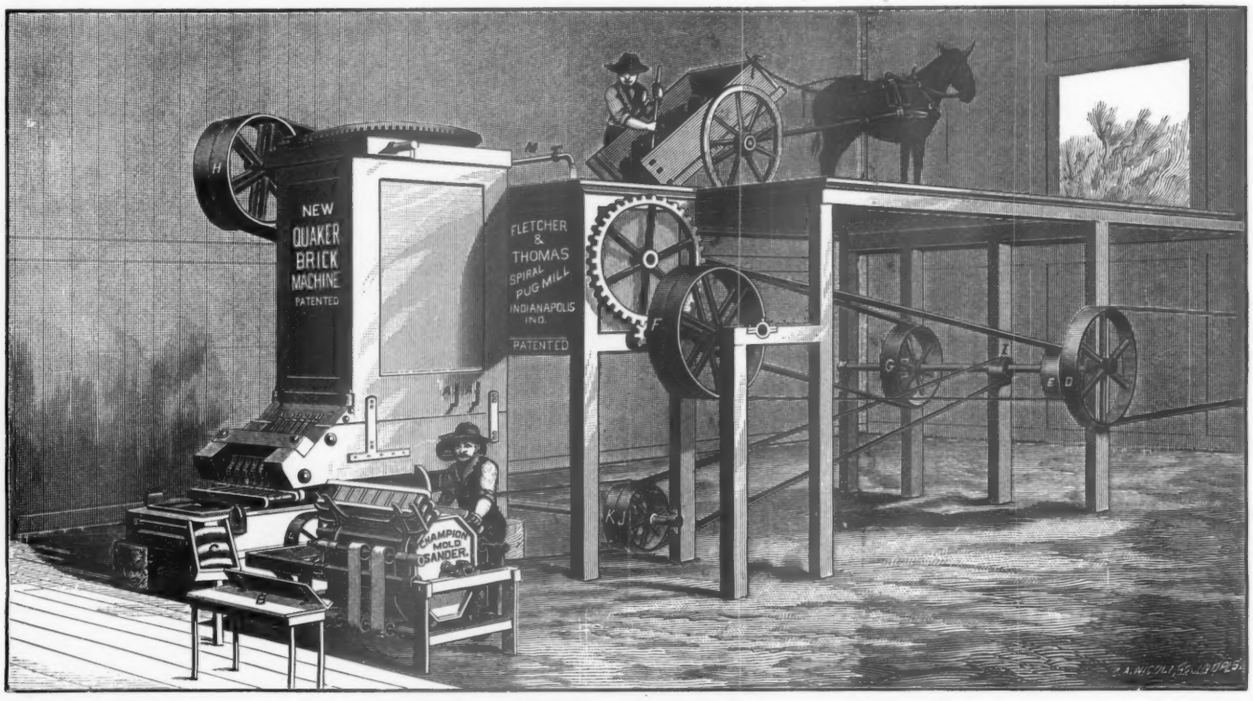

Improved Brick-Making Machinery

The above cut represents the New Quaker Complete Combined Steam Power Outfit. Capacity, 40,000 per day. Capacity of Horse-Power, 15,000 to 20,000. The most perfect machinery for making PAVING BRICKS, FIRE BRICKS or COMMON BRICKS. We make a specialty of equipping yards complete in every detail ready for work. Send for illustrated catalogue.

Correspondence Solicited. **FLETCHER & THOMAS, INDIANAPOLIS, INDIANA.**

RAYMOND'S AUTOMATIC POWER PRESS

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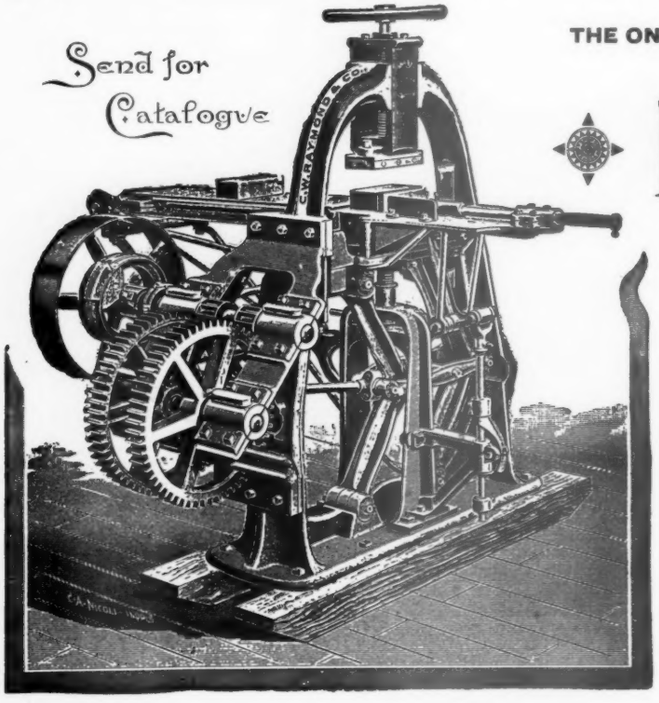

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RED AND FIRE BRICK, ROOFING TILE, ETC.

A rapid working and powerful machine for pressing paving blocks, by which they are given great density and uniformity of size and finish. Make from 8 to 12 thousand finished paving blocks per day. No first-class paving brick made without re-pressing.

Dumping Cars, Portable Track,
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Wrought Iron High Truss Bridge, one Span, 210 feet, over Mississinewa River, at Sharon, Delaware County, Indiana.

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WE BUILD ANY KIND OF IRON BRIDGES WANTED.

Can give satisfactory reference to larger amount and greater variety of work done in Indiana than any other Bridge Company. We are the only Company operating shops in the state. We invite inspection of our shops for efficiency and capacity.

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The Best Bridge for Spans up to 70 feet. We sell only our own Manufacture. Address all communications to

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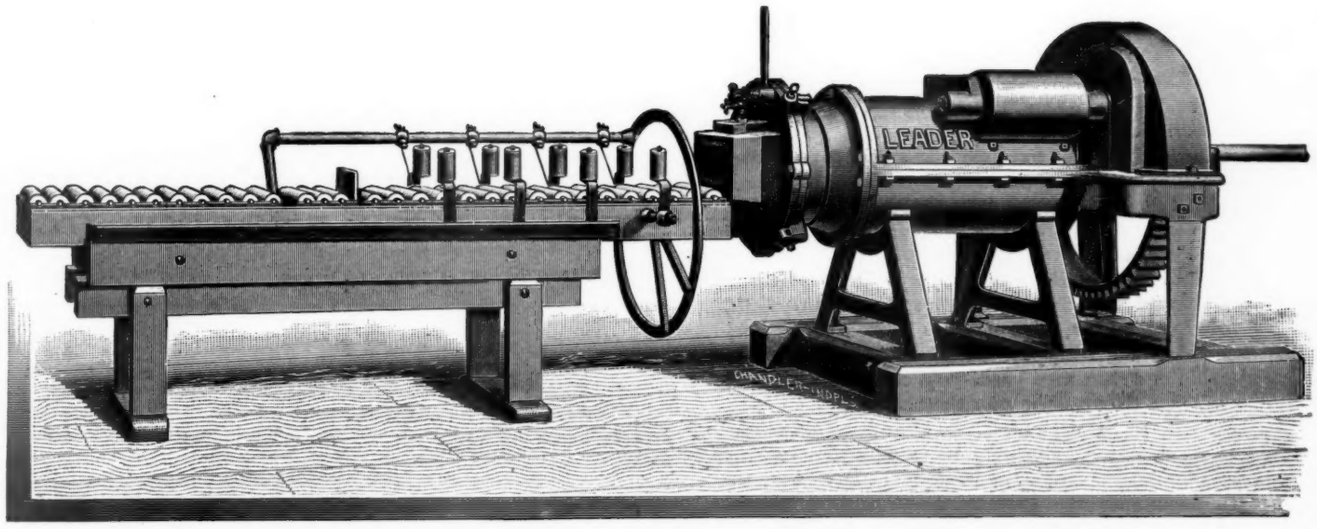
Above cut shows our Patent Leg Bridge.

The Leader The Latest The Greatest The Best



For Making Paving Bricks or Any Other Kind of Bricks.

WRITE FOR CIRCULARS.

The Decatur Leader Manufacturing Co., Decatur, Ills.

GALESBURG PAVING BRICK.

The demand for these Celebrated Brick has hitherto far exceeded the supply. By the erection of one of the largest and most complete plants in the country, the PURINGTON PAVING BRICK COMPANY expects to be able to furnish these Brick in any desired quantity, and to fill all orders promptly and satisfactorily. ∴ ∴ ∴ ∴ ∴ ∴ ∴

Prices and samples furnished on application to

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First National Bank Building, Galesburg, Ill.

LONDON PAVING BRICK.

THESE BRICK are gaining a national reputation for toughness, and resistance to abrasion and the action of frost. LONDON PAVING BRICK have won the laurels in many severe tests, and to-day stand at the head of the list of vitrified paving brick in this country.

Our capacity and shipping facilities are such as to enable us to fill orders promptly. Contractors should make a note of this when wanting large quantities.

SEND FOR SAMPLES AND PRICES

London Clay Co., London Mills, Ill.

CALIFORNIA ASPHALT

THE STANDARD ASPHALT COMPANY, of Bakersfield, Kern Co., California, controlling extensive deposits of genuine asphaltum, believed to be second only to the Trinidad in extent, invite orders for high grade refined asphalt for street paving and other purposes. The supply being practically unlimited, there is no ground for fear that the large and increasing demand can not be met for many generations, notwithstanding those who control the imported article give currency to the idea that there is none in the United States. Our asphalt is fluxed, softened and refined with a natural maltha (liquid asphalt) of 10° to 14° Baumé, forming a chemical and homogeneous mixture superior to the residuums elsewhere used. We can furnish fluxing maltha with our asphalt for the manufacture of paving cement, when desired. We also manufacture the Standard Asphalt Roofing Compound, covered by U. S. and foreign letters patent, flexible, elastic and durable, confidently asserted to be superior to any asphalt pitch or tar roofing ever used. The Standard Asphalt is likewise adapted to and used for pipe covering, electric conduits, reservoir linings, varnishes, etc.

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THE
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MANUFACTURERS OF
Vitrified Paving Blocks
FOR STREETS, ALLEYS, SIDEWALKS, ETC.
QUALITY UNEXCELLED.

FIRE BRICK, FIRE CLAY, ETC.

Prices quoted on application. Correspondence solicited.

THE
Indianapolis Paving
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General Street Contractors.
Brick Roadways a Specialty.

MANUFACTURERS OF
STREET PAVING BRICK.
CAPACITY, 100,000 DAILY.

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"GILSONITE"

Paving Cement

THE FINEST SPECIES
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NATURAL ASPHALT

No Coal-tar Product.

Absolutely Free from Sediment.

FOR INTERSTITIAL FILLING
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BRICK, WOOD or GRANITE PAVING

SUPERIOR TO ANY OTHER MATERIAL FOR THE PURPOSE.

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Over five million square yards in use in the United States.

It has, in fifteen years, raised the streets of Washington and Buffalo from the poorest to the best in the United States.

It will raise the streets of any city that uses it to the same high grade.

It is the only pavement that will do it.

It is the only perfect sanitary pavement.

It enhances the value of abutting property as much as it improves the city using it.

It is the ideal pavement of modern times.

We invite an inspection of our work.

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Asphalt Paving Company in the United States; has laid Asphalt pavements in twenty-seven cities of the Union, on 607 streets of a length of 255 miles, or an area of 8,916,574 square yards. It has laid more pavement in twelve years than all other Asphalt Paving Co's in Europe and America Combined have laid in thirty years.

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THE BEST PAVING MATERIAL

The sapless paving blocks made by us make the best and most economical pavement before the public to-day. We can prove it by hundreds of testimonials. Blocks furnished by the car load anywhere. Our second quality blocks are the best and cheapest for repairing block pavements, or for a substantial floor in warehouses and the paving of private alleys and driveways. Ask for prices.

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FOR THE STATE OF ALABAMA, AND FOR MAKING AND LAYING

—THE—

"Ferrolithic" Artificial Stone.

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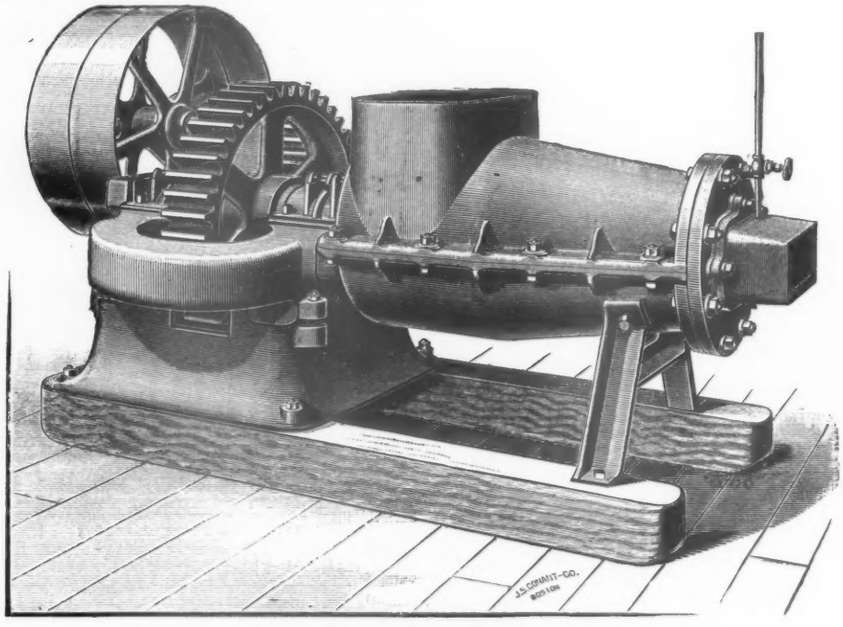
Contractors for Paving Streets and Sidewalks with the best and cheapest Pavement known.

Variety is the Spice of Life

And is a necessity in Brick Machinery. No one machine can work every variety of clay in the world, for what is a perfect success in some clays, in others may prove a total failure. We guard against mistakes by making

FOUR CLASSES OF BRICK MACHINES

enabling us to equip any customer for successful work in his own material.



(No. 5 Auger Brick Machine.)

The latest additions to our list are three sizes of modern Auger Machines, the smallest of which is shown in the cut; also Board Delivery Cut-off Tables, Automatic Cutters, Etc.

When put in operation these machines will speak for themselves by SPEED, QUALITY OF WORK, and STRENGTH. For preliminary particulars,

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